RAILROAD GAZETTE

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NEW YORK: 73 Broadway. | FRIDAY, MARCH 2, 1877. | CHICAGO: 77 Jackson St.

GEORGE A. EVA...
Bethlehem Steel ...ails,
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RAILWAY SAFETY AP... ...NCES.

INTER-LOCKING S... ...EM.

CAUTION.

Whereas, in the year 1856, Letters Patent were granted in England to John Saxby for his original invention of Locking Apparatus to prevent accidents at Junctions; and whereas the said John Saxby, together with John Stinson Farmer, trading under the style or firm of Saxby & Farmer, as Railway Signalling Engineers and Manufacturers, in London, England, are the sole proprietors of the said patent, as well as of several other English patents subsequently granted to them for improvements; and whereas they were the first to introduce the inter-locking system in America, and are now the sole proprietors of three several United States Patents granted to them for such improvements, as well as of a patent granted to John Imray for further improvements; which patents are of number and date as follows, viz.:

United States Patent No. 80,878 August 11, 1868,
" " 131,788 October 1, 1872.
" " 132,416 " 22, 1872
" " 169,811 Nov. 9, 1875, and

whereas of late various Signalling Apparatus have been advertised or made, which are infringements of the above or of some or one of the above-mentioned United States Patents,

All persons and companies are hereby cautioned against making, vending, or using any such Signalling Apparatus which are infringements of the before-mentioned patents or some or one of them; and notice is hereby given that they will be held responsible for any such infringements.

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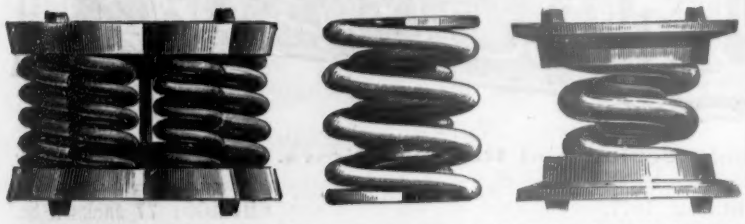

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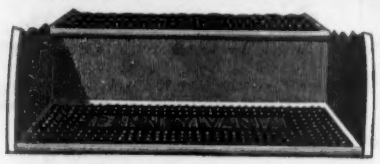

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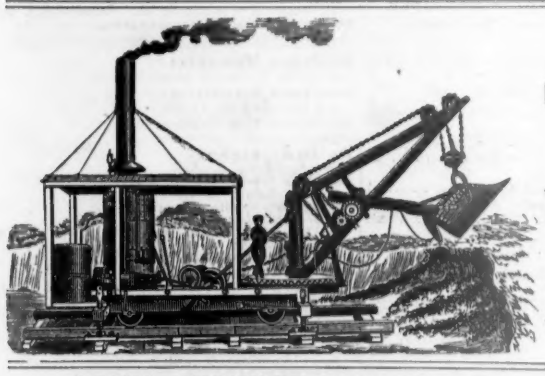

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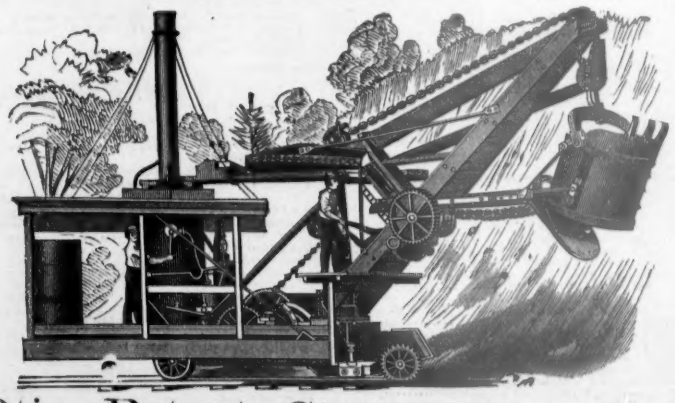

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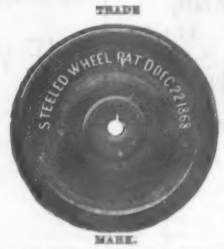

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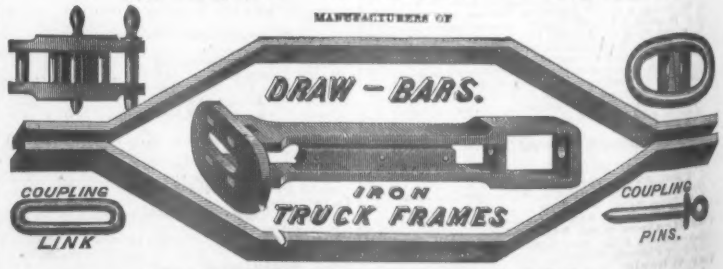

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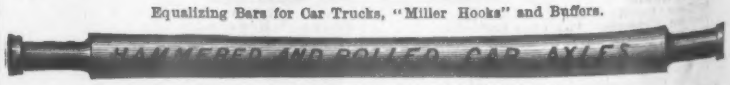

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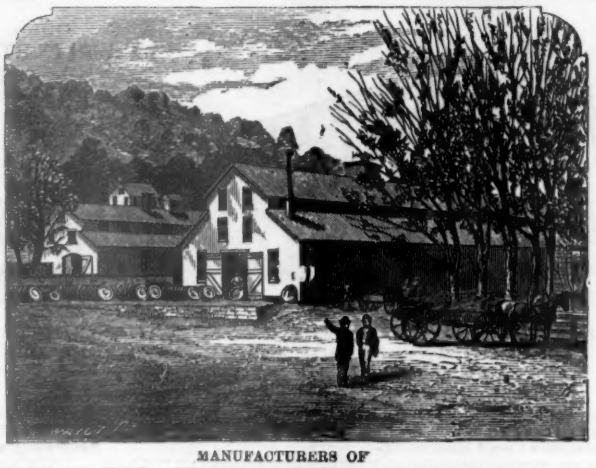

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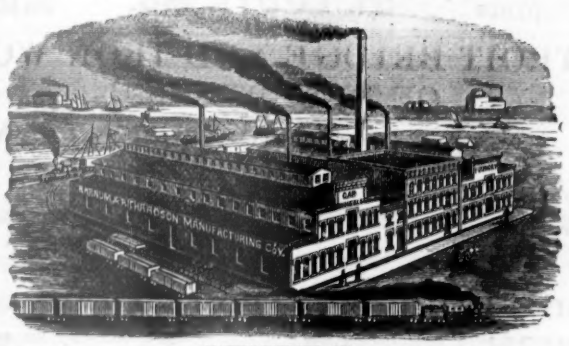

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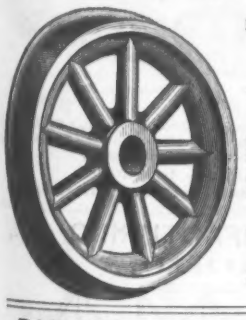

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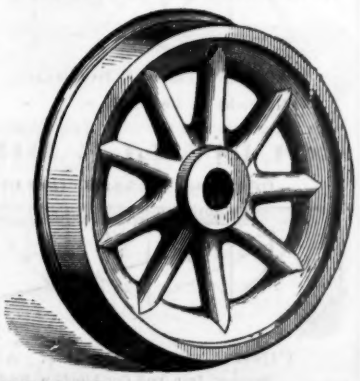

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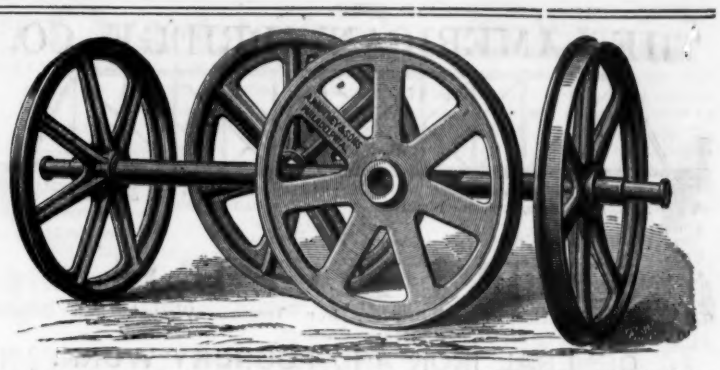

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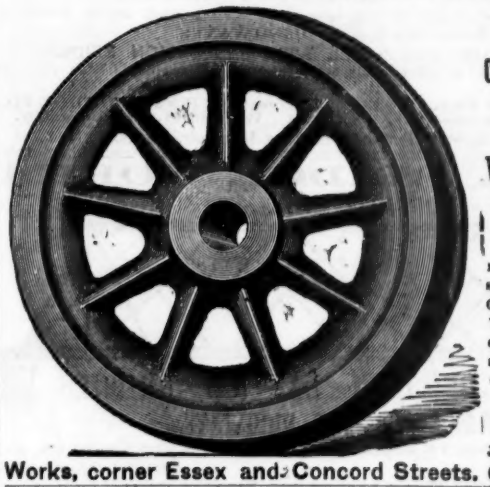

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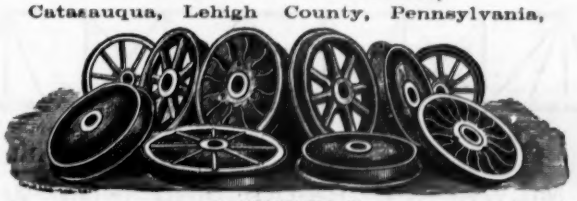

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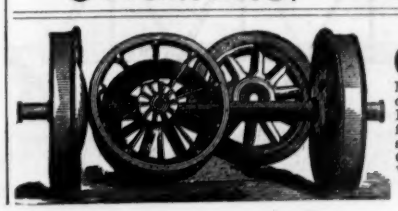

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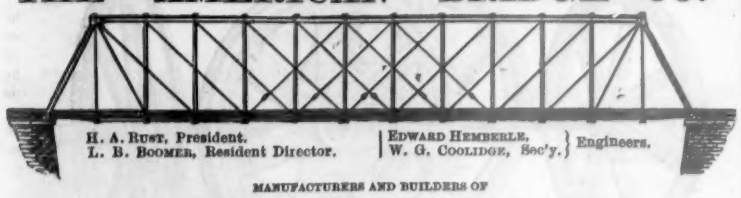

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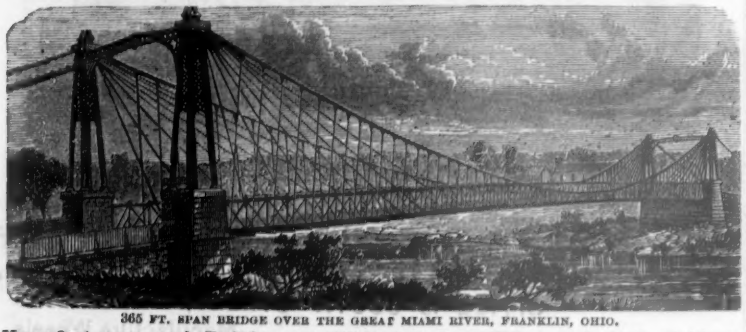

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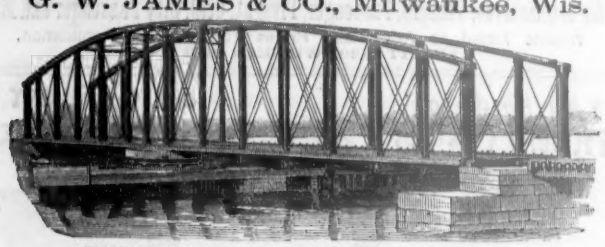

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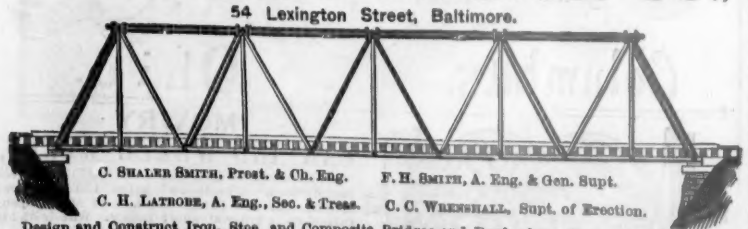

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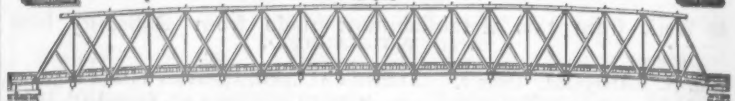

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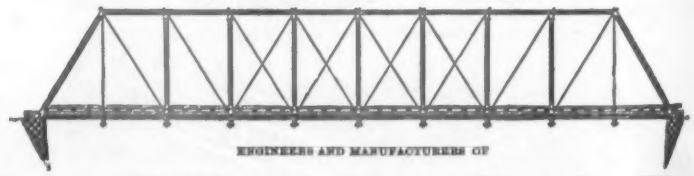

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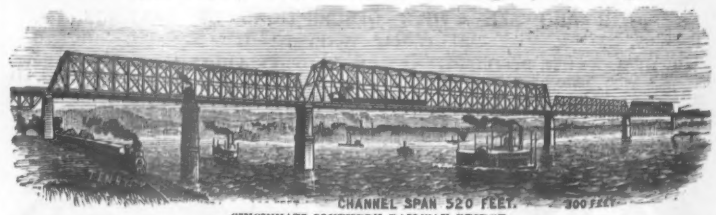

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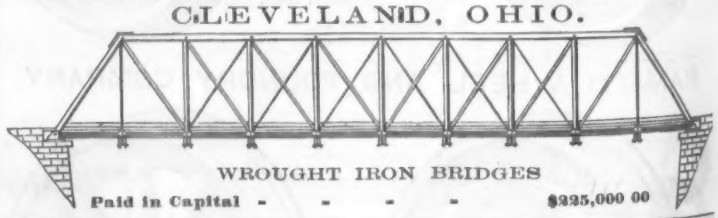

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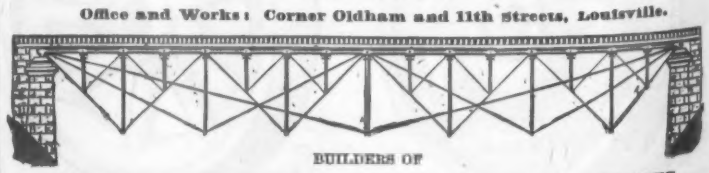

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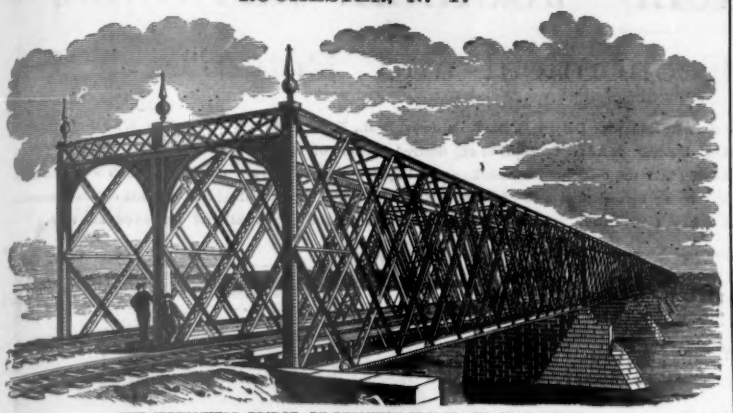

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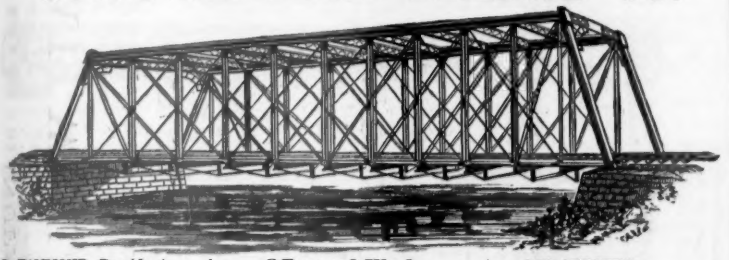

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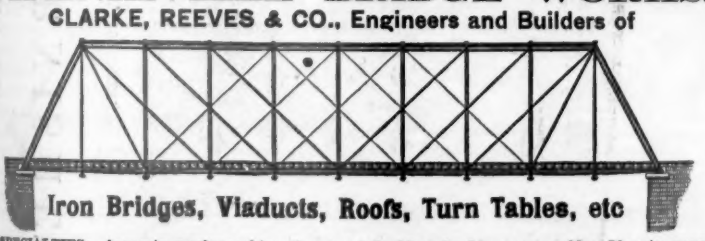

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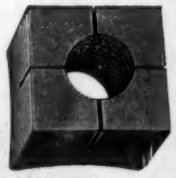

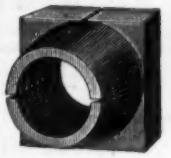

This nut is represented in the engraving on the right, and is made of a conical form on the under side, and fits into the bolt hole which is made of the same shape. The cone and square portions are slotted so that when screwed up into the conical hole, the nut is compressed and clasps the bolt tightly, so that it cannot be shaken loose. The effect of wear is to make it fit the hole more accurately, so that when it is again tightened up it will be less liable to become loose than before it was worn. The conical nut is intended especially for fish plates and bolts.

The engraving on the left represents a square nut cut apart on the top side only. The under side is made concave, so that in screwing it up the hole on the upper side is contracted and clasps the bolt in the same way as the conical nut. The square nut is intended for car work bridges and similar purposes.

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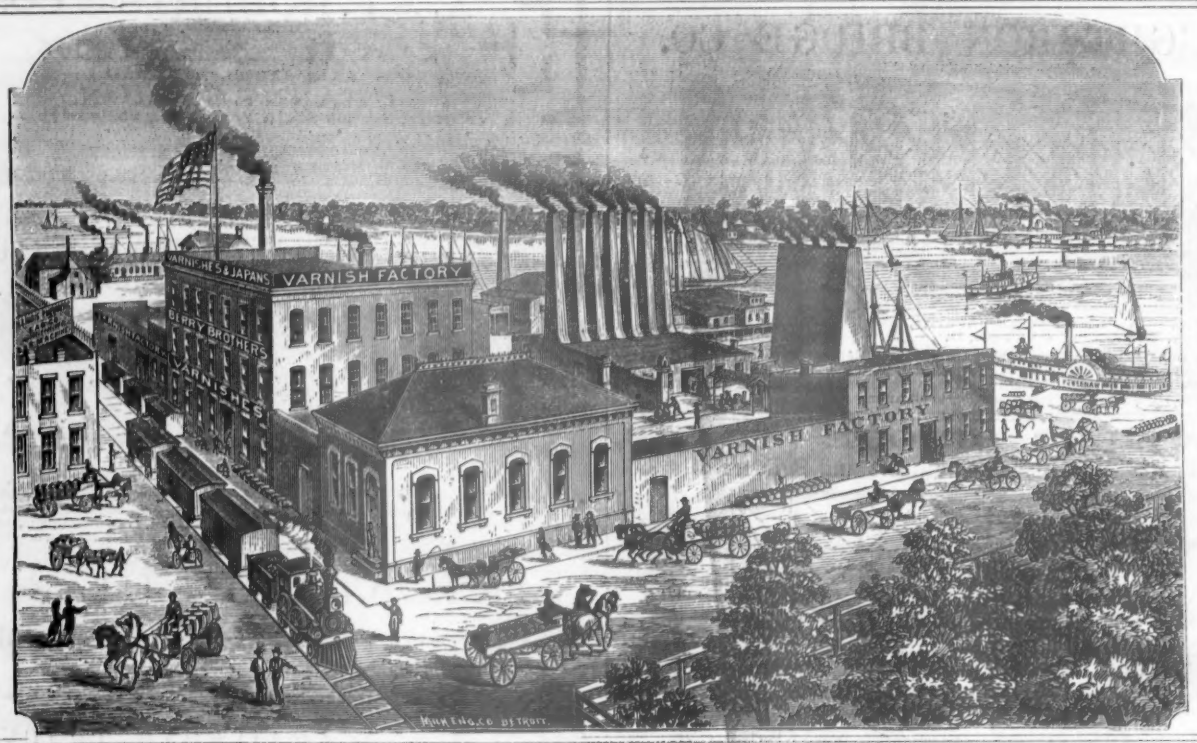

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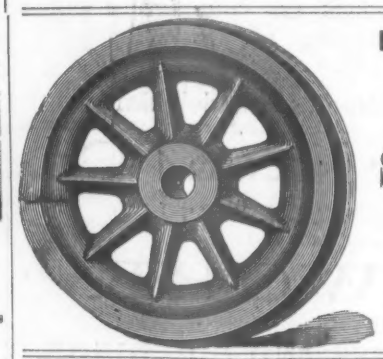

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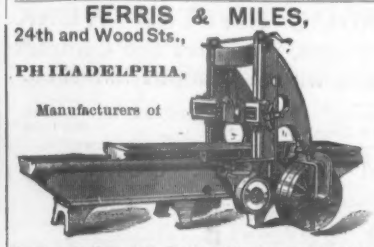

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FRIDAY, MARCH 2, 1877.

Contributions.

The Justifiable Expenditure for Improvement in the Alignment of Railways.

BY ARTHUR M. WELLINGTON, C. E.

[Continued from page 4.]

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THE RELATIONSHIP AND ADJUSTMENT OF THE MINIMUM RADIUS OF CURVATURE TO THE RATE OF THE MAXIMUM GRADIENTS.

If no other paper of this series has met the approval or commanded the attention of the reader, the writer hopes that in the discussion of the present subject he may receive the careful judgment of all those who have to do with the construction or improvement of railways. Although badly adjusted grades have a more calamitous effect on operating expenses, there is no problem connected with location which has such a grave effect on the COST OF CONSTRUCTION as the one we now propose to discuss, nor is there any in which such *discreditable* errors are committed by engineers at the present day from pure want of thought. It is indeed extraordinary that no one of the great number of expensive modern railways has seen fit to expend a few hundreds or thousands of dollars in exhaustive experiments and the collection of definite information as to this most important question which we propose now to consider, viz., the inter-relation of ruling gradients and curvature, and the maximum of each which may be used, separately or in combination with each other, without danger of injuriously affecting the capacity of the road. It is hoped to shed some needed light on this subject, or at least lay some foundation for an abler discussion.

It is the peculiarity of curvature that all its disadvantages lie upon the surface. A heavy grade is very unobtrusive: the most skillful and observant eye cannot detect differences of grade which decrease by a large percentage the operating value of the line. But curves attract instant attention, and their disadvantages appeal even more strongly to the imagination of the inexpert than to the enlightened judgment of the engineer. When we consider that it is both the duty and interest of locating engineers to please their unskillful employers, it is evident that this simple fact must always have a powerful if undetected influence, while human nature remains what it is, and if we further remember that, as a rule, the quickest path to reputation for a locating engineer is through rapidity of work in rushing through surveys, and that it is so much *easier* for him to locate a costly line made up of long straight grades and tangents than one skillfully adjusted at every point to topographical irregularities, in accordance with the exact conditions of operating economy, it will not be surprising if we find that these influences have tended to accumulate a mass of precedents which it requires some courage to defy. Fortunately, topographical and financial considerations have rendered it absolutely impossible in many cases to yield to such temptations, if any such exist, so that precedents are not wanting in either direction.

Passing from these considerations, however, and abandoning all prepossessions, we proceed to analyze, as nearly as may be, the curves which fix the advisable limit of maximum curvature and the cost of exceeding it. A moment's consideration will show that these may all be separated under the two following heads, sharply defined from each other:

1st. *The inherently greater costliness of sharp curvature*; that is to say, the greater wear and tear of road-bed and rolling stock and the greater consumption of fuel which results from 100 feet of 10° curvature rather than from 1,000 feet of 1° curvature. 2d. *The limiting effect of sharp curvature on the weight and length of trains.*

In other words, we are here met, on the threshold of the subject, with a distinction precisely analogous to that which exists in the case of gradients. *All* grades, without distinction and wherever situated, entail a certain additional expense per train passing over them; and, in addition to this, the *highest* rate of grade entails a certain and much greater expense which does not appear at all in the expenses per train mile, but solely in an increase in the number of trains. In like manner, *all* curves, without distinction, entail a certain additional cost per train mile for every degree of curve; and this cost, it may be—or may not be—increases rapidly with the sharpness of the curve; but, in addition to this, the *sharpest* curves on the line *(if they be sharp enough)* will have the further effect of limiting the weight and length of trains.

At a certain definite radius, therefore, the expense arising from short radii takes a sudden jump. The inherent cost per train mile continues on as before, and, in addition thereto, there is a large additional expense on account of the limiting effect of any shorter radius upon the length of trains. A moment's consideration will show that this point is intimately connected with, and depends upon, the rate of the maximum grades, for the latter fixes the maximum length of trains, and the resistance of curves is itself a function of, or varies with, that length. Hence, the shorter the trains which can be hauled *independent* of the sharpest curve, the shorter the radius which may be freely used on levels or minor gradients without affecting the *number* of trains required for a given business.

Now, just as in the case of gradients, this distinction between these diverse sources of expense is one which must be carefully kept in mind if any correct and intelligent decision as to the limit of maximum curvature is to be reached. In the first place, it requires no great effort of mind to perceive that the *first* item mentioned above, viz., the INHERENT COSTLINESS of sharp curvature,—that portion which is visible in an increased cost per train mile for wear and tear and fuel,—affords no ground for the fixing of *any* arbitrary and inflexible limit of curvature, nor should it be considered or allowed to have *any weight whatever* in ascertaining at what radius to fix that limit. For, granting for a moment that the inherent cost of short radii per train mile increases as the square of the degree of curvature—an absurdly exaggerated estimate—it may easily be, and often is the case, that at certain points the cost of construction will vary as the cube of the degree of curvature; and hence a sudden sharp ravine might justify and require a 12° or 14° curve on this account alone, although 3° or 4° curves were the maximum on all the rest of the line. But what we *then* require to determine is, whether any such curve would have the further effect of limiting the weight of trains over the whole line, for in that case a large additional expenditure will be justifiable to increase its radius. This latter expenditure does not vary with the *number* of such curves, as in the former case, but is a certain fixed amount, and must be distributed among one curve or fifty according to their number. This fact alone is sufficient to show the essential dissimilarity between them. The inherent costliness of sharp curvature does certainly have its effect on the justifiable expense to increase the radius of *each particular curve*, for it is to be added in each case to the proportion for that curve of the estimated value of avoiding any limiting effect from its radius; but it does *not* form an element in fixing the point at which limiting effect begins, and hence should be allowed no weight whatever in ascertaining that limit.

All this seems clear enough when the attention is specially called to it, but—as with many other problems which advance from simple premises—it requires a constant effort of the mind to keep it always in view. Hence, although it has no real or necessary connection with our subject, we may first very briefly consider—

THE INHERENT COSTLINESS OF SHARP CURVATURE.

In the article on "Reduction of Curvature" already published, and especially in Table B (page 402, Vol. VIII.), we have implied that the cost of curvature per degree slightly increases with the sharpness of the curve. Light is badly needed on this point, but the writer now regards this as an error, the result of an unconscious confusion on his own part of these wholly distinct questions which he is now endeavoring to separate. If the limiting effect of curvature be rigorously excluded from the mind, it does not seem probable that the *inherent* cost of curvature, per train mile per degree, is any greater on 10° curves than on 1° curves. The cost of fuel (6 cents*) is slightly increased per degree on sharp curves, as is also the cost of iron (7 cents), despite the great difference in the *length* of sharp and flat curves, as would more fully appear from an article on the "Wear of Rails from Grades and Curvature," which the writer hopes to prepare, from data in his possession, at some future time; but, on the other hand, the cost of maintaining road bed and track (6.5 cents) is very greatly decreased; for it is nearly constant per 100 feet of curve, and sharp curves are very much shorter. Moreover, sharp curves *lengthen short tangents*, a consideration of the highest importance which engineers too frequently overlook; and hence a sharper curve doubtless often results in less resistance and wear and tear. The greatest element of the inherent cost of sharp curvature is that the length of the line is always greater between the same tangents, but this is an element given by the comparative surveys (although it may be determined by the table given in the "Note on Reduction of Radius of Curvature" on page 403, vol. viii.), and hence does not *apparently*, although it does *really*, enter into the question.

We may, therefore, perhaps assume that the inherent cost of curvature per train mile is independent of the radius, and this simplifies some questions connected with curvature. But whether the reader be prepared to admit this conclusion or not is a matter of perfect indifference for deciding upon the question in hand, as, it is hoped, has been made perfectly clear.

Dismissing therefore from our minds this confusing and irrelevant question, we will now submit our SECOND question above, the limiting effect of curvature, to the arbitrament of fact.

THE LIMITING EFFECT OF CURVATURE UPON THE WEIGHT AND LENGTH OF TRAINS.

If we know the greatest length and weight of train which can be hauled up the maximum grade of any given road by the most powerful engines which will probably be used; the curve around which the same engine can haul the same train *on a level*, without greater resistance, is evidently the proper limit—*and the only proper limit*—of maximum curvature. This curve may also be freely used on the maximum or any other grade, by reducing the grade to a level for the length of the curve, and an adequate distance beyond it without danger of limiting the weight of trains. We assume that the maximum grade occurs only on tangents, but, if curves are introduced upon it without ample compensating reduction, it in effect increases the maximum grade; hence shortens the possible length of train; and hence shortens the minimum radius which may be used on a level without limiting effect. We shall have occasion hereafter to consider the propriety of such practice.

The reader is requested to admit the above premises before reading further.

We have in the maximum grade two resistances to overcome:

1st. The ordinary rolling friction.

2d. The resistance of gravity;—a known and constant quantity given in Table XVII., Vol. VIII., page 442.

* These sums refer to the estimated cost per train mile of each item for an amount of curvature equal in resistance to one mile of straight and level track, given on pages 401-403, Vol. VIII.

In the case of curvature on a level we have also two resistances:

1st. The ordinary rolling friction, as before.

2d. All additional resistance which may or can arise from the curve.

What we require is, that the sum of the two latter resistances shall be less than (or no greater than) the sum of the two former; and it is evident that the resistance from the rolling friction proper, being the same in each case, whatever its amount may be, may be entirely neglected. We have left only to determine what is the degree of the curve which, *in all cases and under the most unfavorable circumstances*, will oppose no greater additional resistance to the longest and heaviest trains than the resistance from gravity only on the maximum grade. We may express the problem to be solved most concisely and clearly by the aid of a little algebra, of the mildest description.

If we let x = the required degree of maximum curvature;
c = the resistance in lbs. per ton per degree of curvature, on an x degree curve, *per 100 feet occupied by the train*;
l = the longest train which can be hauled up the maximum grade under any circumstances by the heaviest engine in use;
g = the resistance in lbs. per ton due to gravity only on the given maximum grade;

then what we require in order to fix a maximum degree of curvature, x, is that, in all cases,

$$x\,c\,l < g. \quad (1)$$

If, however, we are careful to assign the *largest possible values* (within reason) to c and l, we may determine x by giving this inequality the form of an equation, viz.:

$$x\,c\,l = g, \quad (2)$$

whence we have,

$$x = \frac{g}{c\,l}, \quad (3)$$

or,

$$x\,c = \frac{g}{l}. \quad (4)$$

To solve this equation, we require to determine maximum values for c and l.

The longest trains which may be hauled up grades (value of l). This is a simple question of fact. The longest possible train is one of empty cars. Its absolute length is directly as the weight on drivers, and inversely as the rolling friction and adhesion assumed. We may assume the heaviest engines in common use (see Tables XV. and XVI. pp. 433, Vol. VIII.) as 35 tons on drivers, 60 tons gross, including half-loaded tender. As for the rolling friction, very extended experience in this country and Europe shows that 7 lbs. per ton is about the lowest which can be realized in daily practice on straight grades at moderate speeds. We might substantiate this by numberless authorities, among others by some recent and valuable experiments with heavy trains on the Lake Shore & Michigan Southern Railway by Mr. P. H. Dudley with his dynograph. (See Trans. Am. Soc. Civ. Engrs., October, 1876). The lowest rolling friction there realized was 6.88 lbs. In respect to the ratio of adhesion, there is no variable element in the management of railways more nearly invariable than that; in the daily routine of business, trains are unconsciously adjusted to an adhesion of about $\frac{1}{4}$ at the points of maximum resistance. The trains above referred to, which we may assume to have been as heavy as was prudent (although at the same time they would appear to be in approximate accordance with the daily practice of the line) were adjusted to an adhesion of 1-4.88. These data given, we may construct the following table (Table XXV.) of maximum trains:

TABLE XXV.

Showing the Maximum Trains of loaded and empty cars which can be hauled up various straight grades (uncomplicated by curvature) in the daily routine of business by the heaviest engines in common use on American Railways (35 tons on drivers, 60 tons gross including tender).

Rolling friction assumed at 7 lbs. per ton.

Grade in feet per mile....	Resist. grav. + roll. fric. (lbs. per ton.)	Tons wt. of train. Gross	Tons wt. of train. Net	No. of cars in train. Empty (8 tons)	No. of cars in train. Loaded tons ..... (18	Tot. length of trains (in 100 ft. stations). Empty cars..	Tot. length of trains (in 100 ft. stations). Loaded cars..	Values of $\frac{g}{l}$ = resist. grav. / length train. For empty cars	Values of $\frac{g}{l}$ = resist. grav. / length train. For loaded cars .....
Lev	7.0	2,000	1,940	215	108	72.20	36.50	0.000	0.000
10	10.8	1,296	1,236	137	69	46.20	23.50	0.081	0.160
20	14.6	959	899	100	50	33.80	17.80	0.225	0.427
30	18.4	749	689	76	38	25.80	13.20	0.440	0.860
40	22.2	631	571	63	32	21.50	11.20	0.705	1.35
50	25.9	541	481	53	27	18.20	9.50	1.04	2.00
60	29.7	471	411	46	23	15.80	8.20	1.44	2.77
70	33.5	418	358	40	20	13.80	7.26	1.92	3.69
80	37.3	375	315	35	17	12.20	6.20	2.48	4.89
90	41.1	341	281	31	15	10.80	5.50	3.15	6.20
100	44.9	312	252	28	14	9.80	5.20	3.87	7.28
120	52.5	267	207	23	11	8.20	4.20	5.54	10.04
150	63.8	220	160	18	9	6.50	3.50	8.75	16.25
200	82.8	169	109	12	6	4.50	2.50	16.90	30.30

REMARK.—This table differs from Table XVII., page 80, in that it is made up for a minimum rolling friction of 7 lbs. per ton instead of 10 lbs. per ton; the latter being the rolling friction which is indicated by the loads hauled on various grades which are complicated by curvature. The difference, however, is not due to the *direct resistance* caused by the curves, for that is the same on each grade, like the rolling friction proper; but is probably owing to the limiting effect of such curves on trains in excess of the apparent resistance. The above loads are hauled in daily practice on roads of light curvature and grades.

The last two columns above give values of the function $\frac{g}{l}$ which is required in solving eq. (4) p.—

In the last two columns of this table are given values of

$$\frac{g}{l}\left\{\frac{\text{i. e., resist. grav. per ton}}{\text{length train in 100 ft. stat'ns}}\right\}$$

which we require in solving the formula above (Eq. 4).

Maximum Resistance in lbs. per ton per degree of curvature per 100 feet of train (value of c). On no scientific question of financial importance is there such a dearth of definite knowledge as

on this. The writer has been obliged to evolve an approximation out of his inner consciousness and finally test it by known facts; of which, fortunately, he was able by diligent effort to collect a considerable mass, which may be found embodied in Tables XXVII.—A and XXVII.—B.

Molesworth guesses in his Pocket Book (old edition p. 40) that the *average* value c "may be taken as" 1 per cent. of the rolling friction per degree of curvature. This was for curvature of average sharpness with inflexible wheel bases, and we may assume it as measuring the *maximum* resistance with a flexible wheel base for very flat curves of 1° and 2°. This percentage, however, undoubtedly increases somewhat faster than the degree of curvature, and on a 10° curve we will assume that it is as much as *double*, or 2 per cent. This assumption we shall finally see to be beyond the indications of experience, as indeed it should be. For curves of more than 10° or 12°, the percentage undoubtedly increases much more rapidly until we reach a superior limit fixed by the experience of Mr. Charles Ellet on the Virginia Central Railroad. Mr. Ellet found on the "Mountain Top track" that a reduction of 58.4 feet per mile was not quite sufficient to compensate for the effect of a 19° curve (300 ft. radius) with trains 120 to 150 feet long. The resistance of gravity on a grade of 58.4 feet = 22 lbs.; 22 lbs. ÷ 19° = 1.15 lbs. per degree of curvature, and 1.15 lbs. ÷ 1.20 = 0.925 lbs. per ton per degree of curvature per 100 feet occupied by the train = 9¼ per cent. of the rolling friction (10 lbs. in this case). Assuming 10 per cent. and 18° curves as the superior limit, we may construct Table XXVI. below, the manner of doing which will be sufficiently evident on examination.

TABLE XXVI.

Showing the maximum percentage which the resistance arising from curvature per 100 feet of train bears to the rolling friction proper.

As substantiated by the experience with limiting curvature of all American railways, as shown in Tables XXVII.—A and XXVII.—B.

Degree of Curvature.	Percentage of curve resistance per 100 feet of train to the rolling friction proper.			Total resistance of curve in lbs. per ton per 100 ft. of train = per cent. in previous column × 7 lbs. per ton.
	Per degree of curve.		Total.	
1°	1 p. c.	× 1 =	1. p. c.	0.07 lbs. per 100 ft. of tr'n.
2°	1 "	× 2 =	2. "	0.14 " " "
3°	1.1 "	× 3 =	3.3 "	0.23 " " "
4°	1.2 "	× 4 =	4.8 "	0.336 " " "
5°	1.3 "	× 5 =	6.5 "	0.450 " " "
6°	1.4 "	× 6 =	8.4 "	0.588 " " "
7°	1.5 "	× 7 =	10.5 "	0.735 " " "
8°	1.6 "	× 8 =	12.8 "	0.896 " " "
9°	1.8 "	× 9 =	16.2 "	1.134 " " "
10°	2. "	× 10 =	20.0 "	1.4 " " "
11°	2.4 "	× 11 =	26.4 "	1.848 " " "
12°	2.8 "	× 12 =	33.6 "	2.352 " " "
13°	3.2 "	× 13 =	41.6 "	2.912 " " "
14°	4.0 "	× 14 =	56.0 "	3.92 " " "
15°	5.0 "	× 15 =	75.0 "	5.25 " " "
16°	6.0 "	× 16 =	96.0 "	6.72 " " "
17°	8.0 "	× 17 =	136.0 "	9.52 " " "
18°	10.0 "	× 18 =	180.0 "	12.6 " " "

REMARKS.—The rolling friction is assumed at 7 lbs. per ton, the same as in Table XXV. If it were assumed higher, the aggregate curve resistance would be higher, but the length of train proportionately shortened so that the result would be the same.

The preceding table gives a very large aggregate curve resistance. Thus, for a train 1,600 ft. long (about 46 cars) on a 10° curve we have 1.4 lbs. × 16=22.4 lbs. per ton, this being equivalent to the resistance from gravity only on a 60 ft. grade. This excess over the actual resistance, however, is essential in order to include the full *limiting effect* which curves have in excess of their nominal resistance as pointed out below.

The latter column of Table XXVI. gives the values $x\ c$ which we require in order to solve equation (4) above. We have already determined maximum values of $\frac{g}{l}$ (see Table XXV.); and, by interpolating those values in the last column of Table XXVI. above, we shall have opposite to it the corresponding value of x required. For example: the value of $\frac{g}{l}$ for a 60-feet grade is, for empty cars, 1.44 lbs. per ton. Interpolating this value in Table XXVI., we find the corresponding value of $x\ c$ to be opposite a 10° + curve, the latter being, consequently, the degree of the curve which, under no circumstances which can properly be provided, will oppose as great a resistance to the longest and heaviest trains as will be encountered from gravity only on the maximum grade.

Table M. gives the degrees of curvature thus deduced, and its construction and manner of application will now be sufficiently evident by an examination of the table itself with its accompanying notes.

TABLE M.

SHOWING THE CURVE ON A LEVEL WHICH WILL HAVE LESS LIMITING EFFECT THAN ANY GIVEN STRAIGHT GRADE ON A TANGENT, ON THE LONGEST TRAINS OF LOADED OR EMPTY CARS WHICH CAN BE HAULED UP THAT GRADE BY THE HEAVIEST ENGINES IN COMMON USE (35 tons on drivers, 60 tons gross).

As substantiated by the average daily experience of all American railways as set forth in Tables XXVII.—A and XXVII.—B.

Rate of Maximum Grade on Tangents.	Curve of equal resistance on a level.	
	Trains of Empty Cars.	Trains of Loaded Cars.
Level.	Tangent.	Tangent.
10	1° 10′	2° 10′
20	3°	4° 50′
30	5°	7° 50′
40	6° 50′	9° 50′
50	8° 30′	11° 20′
60	10°	12° 40′
70	11°	13° 40′
80	12°	14° 40′
90	13°	15° 30′
100	14°	16° 10′
120	15°	17° 10′
150	16° 40′	18° +
	18° +	

REMARKS.—This table is deduced by comparison between Tables XXV. and XXVI., as set forth in the text, and is believed to err on the safe side. As it rests solely on rudely-observed facts, however, and not on experimental data, it is liable to err slightly in either direction on the higher curves.

Reversed curves cause a greater inherent expense for wear and tear than simple curves, but—if they be connected by tangents not less than 50 feet long per degree of curve—they cause no appreciable loss of power over a continuous curve.

Curves shorter than the average train length may properly be made somewhat sharper than the above table indicates in proportion to their shortness, when occasion arises. This difference, however, should hardly be more than 1° for a curve half a train-length long.

The reduction in grade for curves should never be less than 0.1 per station to eliminate their limiting effect, as set forth in the text. This reduction, moreover, should *in all cases* extend half a train-length above the curve at the upper end. On the other hand, it may begin about ½ of a train-length on the curve at the lower end. These (and all) changes of grade should be connected by long and easy vertical curves.

Trains are never fully loaded even with an evenly balanced traffic. The best average practically possible in the latter case is about ⅝ of a load. See remarks below, on page —.

So far with theory and guesswork; let us now test all this by the results of experience. In Table XXVII.—A and XXVII.—B† will be found detailed statistics of trains which are regularly hauled around limiting curvature on 30 different railways, parts of railways, or classes of trains. *All exceptional or occasional performances have been carefully and rigidly excluded* (except as stated in the notes) in addition to a large number of cases for which one or more of the many data required could not be ascertained with proper certainty. The curves, it will be observed, range from 6° to 20°+, for trains of both loaded and empty cars, and the curvature is in every case such as had an unmistakable limiting effect. In the last columns of these tables are given the maximum resistances which can possibly be considered as arising from the curve, as deduced by deducting minimum values for the other sources of resistance from the tractive power of the engine, assuming it to be fully exerted; and it will be observed that in a majority of instances the resistance is less than that given for the same curve in Table XXVI., from which Table M. was deduced; the most unstable exceptions being in a few cases on very heavy grades with short trains. The writer submits that these facts, in connection with the extreme care everywhere taken to keep well on the safe side, entitle Table M to a high degree of credence as an *entirely safe* table for practical application in the location of any railway:—always provided that it is intelligently and correctly applied in the manner we shall set forth below. The writer, however, clearly appreciates its essentially defective and empirical character, and, especially on the sharper curves, it may err slightly in either direction; but this was unavoidable. The pains taken in the collection and analysis of the basis of fact has been very great, but an amateur investigator cannot command those facilities which are essential for a more definite result.

A few inexpensive experiments by any railway would remove this unavoidable condition of uncertainty, and give to engineers a positive and entirely trustworthy solution of a pre-eminently important financial problem; but the question is of importance only to "railroad stakers-out," and after forty years of devil-may-carelessness it is probably useless to expect that any one will see fit to make them. All the brains of the profession seem to be absorbed in the effort to save a few pounds of iron in Phœnix columns and sail as close to the wind as possible in the proportions of eye-bars. For example, in the last "Report on the Progress of Work" of the Cincinnati Southern Railway may be found a baker's dozen of carefully prepared plates of the class referred to—and the writer would be the last to deride their value; but it is not on record that any experiments were resorted to or any pains taken whatever to determine what should be the proper limits and interadjustment of their maximum curvature and grades—in fact it is very evident that the subject was not even given a careful mental analysis—and we propose to consider the consequences of this unfortunate oversight. Doubtless the care of these engineers has gained them some very good bridges, but they have "strained at a gnat and swallowed a camel" with a vengeance, for what they did NOT do has cost them more than enough to duplicate every bridge upon the line, and every tunnel also, and very possibly the greater portion of their masonry in addition. But the writer wishes it distinctly understood that he selects this railway for criticism, not because it is exceptional, but because it is prominent and *not* exceptional. He reflects with pain upon the professional judgment of any man, but it is time that the truth should be pointed out and made clear; and by selecting this railway as one out of many, he hopes to show in a few words where millions of money have gone and are going.

The standard adopted on the Cincinnati Southern Railway was as follows:

1*st*. *No grade shall under any circumstances exceed 60 feet per mile.*

2*d*. *No curve shall under any circumstances be sharper than* 6°.

But:—

3*d*. *These limits may be freely used in combination with each other; i. e., 6° curves may be inserted in unreduced 60-feet grades.*‡

We will grant for a moment the propriety of the first and third standards, and consider the second: If we may use 60-feet grades + 6° curves, WHY should we not use sharper curves on lower grades or on a dead level, if we can thereby save an honest penny?

The answer can only be one of three reasons:

1*st*. A 7° or 8° or 10° curve of the same angular length is so enormously more costly in wear and tear that *in no single case* on this costly line would the saving in cost of construction have paid for the loss therefrom; or—

2*d*. A 7° curve on a 45-feet grade, or an 8° curve on a 30-feet grade, on a 10° curve on a level has such a *powerful limiting effect upon trains* that the same engine would not haul the same train around them as around a 6° curve on a 60-feet grade; or—

3*d*. A 7° or 8° or 10° curve is so *exceedingly unsafe* that the additional danger therefrom would in no case have been repaid by an adequate economy in construction.

There is no escape from accepting some horn of this trilemma, if the standard adopted is to be justified at all; and any man who could maintain any one of them must be wandering in mind. In commenting upon such an utter and evident blunder as this, it is difficult to maintain that tone of moderation and courtesy which should characterize a scientific discussion. When we consider that every one of the great trunk lines has 8° or 9° or 10° curves and moves more cars over them in a month with unsurpassed efficiency and economy than the Cincinnati Southern Railway will ever move in a year; when we consider that many railways of large traffic have 10° and 12° curves which result in no serious danger or expense per train mile; what is the Cincinnati Southern Railway that it should set up an inflexible standard of this kind and stick to it regardless of cost; even if it had saved a trifle in expenses or danger which is very doubtful? We pass to the second branch of our subject, viz., the propriety of allowing no grades higher than 60 feet per mile, and yet having 6° curves on that grade.

This standard we may regard with more patience, for it may be plausibly justified by such reasoning as this: That on the whole the *average* is about the same; that if grades are lower on curves they must be higher on tangents; and that engines would lose on the tangents all that they gained on the curves. In other words, this position assumes that in the daily routine of business engines may be relied on to do a little more work on curves than they could continuously; because on the intervening tangents they will have a little *less* work to do, and will thus accumulate steam and get up headway to carry them through the next curve. It follows that if higher grades were used on tangents than on curves, the engine could not do this, and hence the higher grades would have a limiting effect on trains, and injuriously affect the value of the line. The writer hopes he has stated this position fairly and forcibly.

The first fallacy in this reasoning is a neglect of the elementary principles of the steam-engine. We can overcome momentarily excessive resistances in only two ways. The first of these is by varying the point of cut-off and using more steam for the moment than we can produce continuously. The wasteful effect of this practice, when the engine is already working close to its full power, is shown without further demonstration in Table XXVIII. It is sufficiently evident that if we were to *spurt* around occasional curves in this manner the engine would need to be relieved of 3 to 4 foot-pounds of work elsewhere for every foot-pound thus performed.

TABLE XXVIII.

Showing the cost in steam of any additional power gained by varying the point of cut off.

Point of Cut off.	Increase p. c. in steam used.	Average pressure (initial pressure 100 lbs.)	Increase p. c. in power.	Increase p. c in power per 100 p. c. increase in steam used.
1/4		38.5 lbs.		
1/3	100 p. c.	59.6 "	54.8 p. c.	54.8 p. c.
1/2	50 "	74.2 "	24.5 "	49. "
2/3	33⅓ "	84.6 "	14.4 "	43.2 "
3/4	25 "	91.9 "	8.6 "	34.4 "
4/5	20 "	96.4 "	4.9 "	24.5 "
5/6	16⅔ "	99.2 "	2.8 "	16.8 "

REMARKS.—The average pressure is computed by the ordinary formula for steam used expansively, to be found in any of the pocket-books (except Trautwine). The above table represents about the extreme variations as to cut-off for the locomotive engine.

As a matter-of-fact, no runner ever resorts to this practice as an habitual reliance, and the only other method of equalizing an unequal resistance is by *acquiring momentum*, or, in other words, by a constant alternation of high and low speeds. This butting process is excessively expensive at best, for the speed must be considerable if the accumulated momentum is to be of much service. Every time the locomotive enters or leaves a curve, a shock more or less severe runs through the train, and this kind of action is one great cause of locomotives wearing out so much more rapidly than stationary engines, as any one will perceive who will consider the effect on a stationary engine, *running without a governor*, of rapid changes of load or speed.§ In order to *economize* in construction we must often put up with this disadvantage and introduce varying resistances, but to *expend money* to do so by keeping down tangent grades to the curve maximum is the worst of bad practice. But, even if the process were inexpensive:

2*d*. As soon as the adhesion is lessened for any reason the *possibility* of this course is destroyed; for a low speed is then unavoidable and there is no available momentum. The same is true if trains are stopped or steam production checked for any cause on ruling grades. Now all trains are at all times exposed to such contingencies, and no railway can afford to, or does, *take chances* in such matters or vary its practice according to the daily "probabilities." It will and should, adopt

† The writer was unable fully to complete Tables XXVII.—A and XXVII.—B in time for publication with this paper, and as they are very voluminous, it has been decided to omit publication in the *Gazette* and include the tables only in the reprint of these articles. They do not involve or affect the *principle* discussed in the present article, but only serve as an indication of the extent to which it may be safely applied.

‡ We select for discussion the standard of "Operating Division 3." That for each of the others was similar in principle, and as follows:

Operating Division 1, .. 26.4 feet grades and 4° curves.
" " 2, .. 52.8 " " " 5° "
" " 4, .. 40.0 " " " 4° or 6° curves.

It is possible that in the latter case the principle we are contending for was so far recognized that 5° or 6° curves occur only on minor gradients.

§ It is not uncommon to hear engineers reason by analogy from the horse, and actually *advocate* this process, recommending that short stretches of level be introduced in maximum grades to enable the engine to get up headway. No error could be more gross or ruinous. The economy of this practice in the case of the horse rests on physiological reasons, but the locomotive has no muscles to be relieved. It is a simple problem of so much steam, so much work in such and such a time. The necessary foot-pounds of work are increased instead of diminished by the levels, and steam is used far less economically than if the *whole* grade were uniformly reduced by a corresponding amount. It is doubtless true that if we could cut up all our maximum grades into short sections of one to three miles, we should appreciably benefit the line; but *short* breaks of grade for other than topographical reasons are always disadvantageous.

such habitual loads as are *sure* of going through without stalling, and the inevitable effect is that trains are adjusted, not to an average between the tangent of curve resistance but to the *maximum* resistance in the strict sense of the word. But, granting that this averaging or butting process is both inexpensive and possible, on curves of moderate length:

3d. The Cincinnati Southern (and most other such railways) is estopped from pleading either of the above arguments, because the curves on the maximum grades are so frequent and long that the butting process is *under any circumstances* an impossibility. The writer heard of one curve over 2,000 feet long (120°) on the maximum grade, with others approaching that limit in close proximity. On many railways even larger curves are introduced. No momentum can be relied on to carry trains around such curves, even if there were opportunity to accumulate it, which can never be relied on. But (here we enter on an argument of still greater force), even if such curves be all short and our previous reasoning has no force whatever:

4th. The arguments by which the averaging theory is justified neglect some important facts as to the nature of curve resistance. The writer had hoped to base this paper upon a scientific demonstration of the exact nature and extent of these forces by an engineer whose well-earned fame would carry an authority which his own words cannot; but the requisite experimental data were not available, and as they would involve the expenditure of a few hundred dollars by some railway, they probably never will be available. Fortunately, however, the statements we shall make are of such a character that every practical reader will recognize that such facts exist and are operative to some unknown extent, notwithstanding the fact that the statements made are of necessity based solely on the writer's rude deductions from observed facts.

The law of curve resistance is such that the *average resistance per ton*, and the *limiting effect* of curvature, have very little connection. When a train is bowling along at a fair rate of speed under full control, the curve resistance is comparatively a minor matter; but as soon as, for any reason, the train begins to *labor* on the curve, and speed is checked, the resistance, even in pounds per ton, is increased to a greater or less extent, on account of the fact that the lateral resistance caused by the super-elevation and obliquity of draft, is no longer balanced in any degree by centrifugal force. How much or little effect this cause may have cannot at present be determined, on account of the profundity of professional ignorance on this subject; but it is a matter of general notoriety that it has *some* effect, and there is another fact to be considered of far greater importance. The resistance caused by each car is not uniform, as on a grade. Of the various lateral forces which in the aggregate cause the greater portion of curve resistance (for the slipping of wheels resolves itself into a lateral force), the most important, or almost the most important, is that caused by the obliquity of draft, and this increases in a geometrical ratio (more or less rapid according to undetermined laws) with the length of the train, *and with the grade on the curve.*‖ The last cars undoubtedly cause a far greater resistance than the average of the whole train.

Now, however difficult it may be to determine the effect of all these forces theoretically, the locomotive runner is not long in finding it out practically. He is loaded, perhaps, with trains of 30 cars, and finds he is sometimes stalled. His train is then cut down to 27 or 28 cars. *Now* the conditions are entirely different. He has ample power, and hence no need of it; and if the resistance of such a train were measured on 60-feet grades + 6° curves, it would probably be found that it was only equivalent to about 68 or 70 feet per mile. *But if it should be attempted to reload his engine to anything like its full capacity as thus indicated*, it would at once be found that the resistance would mount up, under *unfavorable* conditions, to that arising from a grade of 80 or 84 feet per mile, and his train would be stalled. Now, it is self-evident that we may (and should) so design our alignment that engines may always *be* loaded to their full working capacity at any or all points, and hence 80 or 84 feet per mile is the equivalent straight grade which we may freely use, and yet it is very true that, if we do so, the resistance in the daily routine of business, would undoubtedly be higher on the 84-feet grades than on 60-feet grades + 6° curves; *but this over-plus of power on the latter is absolutely essential*, in order that the curve resistance, mainly caused by the *last cars* of a train, may be in no danger of so mounting up on us that we cannot handle our train at all. By using a *little* lower grades on tangents—say 70 or 75 feet per mile—we might then trust a *little* to the butting process, and possibly squeeze through more than if we used 84-feet grades, at a cost about twice as great as if it were hauled in a separate train. It does not require demonstration that no engineer is justified in reducing grades for such a purpose if it adds anything whatever to the length and cost of his line.

We have tried to make this argument as clear and plain as its importance demands; but, for any one who cannot or will not admit it, we add unimpeachable facts. We have claimed that the Cincinnati Southern alignment is equivalent in limiting effect to a straight grade of 84 feet. Referring to Table XXV., p. —, the corresponding net load of empty cars for a 33-ton engine (on drivers) is 33 to 35 cars. Long experience on the Eastern Division of the Erie Railway has shown that the maximum load of empty cars hauled in daily practice over 60-feet grades+5° curves is 35 to 40 cars by a 37¼ ton engine. This proves the fact Q. E. D., for nothing is more fully established by experience than that a 35-ton engine might be relied on to haul nearly or quite 46 empty cars on a *straight* 60-feet grade, as indicated in Table XXV. (this corresponding to a rolling friction of 7 lbs. per ton), if all curves were *heavily* and *amply* reduced. The latter is the vital point. All or nearly all high-grade railways are needlessly suffering from the effect of limiting curvature, because, if a reduction of grade has been attempted at all, it is too little to be of real service; and consequently very few railroad men appreciate what heavy loads might be hauled on straight maximum grades. For example: the Central Pacific and many others reduced 0.05 per station per degree; and the Pennsylvania, the Baltimore & Ohio and others, only 0.02 per station. This is little better than nothing. It may equalize the *average resistance*, but to equalize the *limiting effect* the reduction should be about 0.1 per 100 feet, or 5 feet per mile. The effect of this error is visible in the fact that the trains hauled on these and many other railways are *apparently* adjusted to a rolling friction of 10 lbs. per ton instead of 7 lbs., as we have already pointed out; and yet these same trains will in no case give evidence through a dynamometer of a higher rolling friction than about 7 or 8 lbs. per ton; and the latter is actually realized *in daily practice* on the Lake Shore** and many other railways of easy curvature and grade. The writer has once explained this curious fact as probably due to the allowance for emergencies which experience has shown to be advisable; but further investigation leads him to believe that this explanation is true only when taken in connection with the considerations above advanced. *Some* railways, favored by nature, do not find it necessary to provide for such emergencies. Moreover, all grade reduction for curvature should begin a short distance *on* the curve at its lower end and end half a train-length *beyond* the curve at the upper end, for evident reasons which we cannot enter into. These grades should also be connected by LONG AND EASY vertical curves. If all these minutiæ be not attended to, we shall still have limiting effect from curvature; but, if we do so, we may use very sharp curves when necessary to economize in construction. For example, in the case of the Erie Railway above, the same trains are hauled with less difficulty around a 10° curve on a 25-feet grade than up the maximum grade, as will be seen by referring to the foot notes to Table XXVII.—A and B. A lesson of great value to the Cincinnati Southern Railway might have been learned from that curve, at no greater cost than about $12.50 out of $12,500,000 for a ticket to New York.

Now what the railway in question (as well as many others) *should* have done, was to adopt no inflexible standard of either grades or curvature. A little of that admirable care which has given it such excellent eye-bars should have been diverted to the construction of a well-devised *sliding scale of adjustment* between grades and curvature. Information should have been sought in every direction, by personal investigation and experiment, before driving a stake; and if we may suppose that—with the greater facilities the designers would certainly have and the greater ability they might easily have—they would have reached substantially the same conclusions as those which the writer has reached with labor and difficulty and embodied in Table M. This sliding scale would have been about as follows:

TABLE N.

SHOWING A GRADUATED SCALE OF ADJUSTMENT BETWEEN GRADES AND CURVATURE; BEING VARIOUS COMBINATIONS O EACH WHICH HAVE AN EQUAL LIMITING EFFECT IN THE LARGEST AND HEAVIEST TRAINS.

Adopted for a road having maxima of 60-feet grades + 6° curves.

In combination with a grade of		The maximum curvature permissible is	Possible modification of table for more perfect safety.		
feet per station.	ft. per mile.		feet per station.	feet per mile.	Curve.
1.6	84 ft.	Tangent	1.5	79	tang.
1.5	79 "	1° 30′	1.4	74	2°
1.4	74 "	3°	1.3	69	3° 30′
1.3	69 "	4°	1.2	63	5°
1.2	63 "	5°	1.1	58	6°
1.1	58 "	6°	1 0	53	7°
1.0	53 "	7°	0.9	48	8°
0.9	48 "	8°	0.8	42	8° 30′
0.8	42 "	9°	0.7	37	9°
0.7	37 "	9° 30′	0 6	32	9° 20′
0.6	32 "	10°	0.5	26	9° 40′
0.5	26 "	10° 30	0 4	21	10°
0.4	21 "	11°	0.3	16	10° 15′
0.3	16 "	11° 30	0.2	11	10° 30′
0.2	11 "	12°	0.1	5	10° 45′
0.1	5 "	12° 30′	0.0	Level	11°
0 0	Level.	13°			

Possibly intelligent investigation would show that, if the cost were but trifling, it might be advisable to keep more entirely on the safe side by slightly modifying this table at either end, as shown in the latter columns; but it is to be remembered that it is in no way more important to have the limiting effect of the combinations at the top and bottom of the table less than that of the combinations in the middle of the table than *vice versa*.

Now such a scale as this, wisely and intelligently used would have given to the line an almost marvelous flexibility. When we encountered a sharp spur or a deep gully, we could use the combinations at the *bottom* of the list, and swing around it with light work: where tangents or easy curvature did not cost much, we could use those at the *top* of the list, and thus run down rapidly to our crossings and run up rapidly over our tunnels. If we attempt to keep to *any one of them exclusively* we have our hands full at once; but by passing in this way from one to another we could reduce almost any line through the roughest country to very light work if it were a line of light traffic, or adopt it to such a standard as its traffic justified. Why should we not do this? It requires judgment and knowledge and skill doubtless to do so without blundering, and much more time devoted to surveys; but is there any other sound objection? All of the above 17 combinations are precisely equivalent in limiting effect, and any difference in the inherent cost of each is so absolutely trifling as to be unworthy of mention, although not therefore *unworthy of consideration*, in adjusting the detailed alignment. We have entered into those questions too fully to have our meaning mistaken. The effect however of a very considerable addition to the number of degrees of curvature or feet of rise and fall *which have no limiting effect* is comparatively *trifling*. Yet out of the whole seventeen the Cincinnati Southern Railway pitched upon *one*,—why that one in particular it would be hard to say—and forbade the use of any other of its *precise equivalents*, however great the economy which might thereby be effected. If location were as carefully studied as bridge-building, this would be thought to indicate almost the last extreme of ignorance, like making every bar in a truss of equal strength. Suppose some plain country farmer should find that his team could just draw him up a steep hill through mud a foot deep, and should forthwith draw two conclusions: that it could not draw him up any steeper hill *without any mud*, nor through any deeper mud *without any hill;* should we not write that man down an ass? Yet this is precisely what has been done on the railway in question (and many others); and that, too, when there were 12,500,000 good reasons for thinking the problems out carefully—if it can be called a problem—while our farmer would be lucky if he only had one. The only *advantage* derived from this cast-iron rule is, that the unskillful trustees fancy they have a line which they have not. It sounds very much prettier to talk of 60 feet and 6° maximums than of 84 feet and 12° maximums. Yet the latter is what they have *in effect*, and the operating value of the line is no greater by a penny's worth than if they had them in fact. For they may to-day increase any one of their 60-feet grades on a tangent to 84 feet per mile, or sharpen up any one of their 6° curves on a level into a 12° curve, and they will not have affected in the slightest degree the operating value of the line. If there were any slight difference in rail wear, etc., in the latter case, or in the effect on passenger traffic in the former case, it would be so ridiculously trivial as to be unworthy of mention.

Now, if this be so, it becomes of importance to remember that the effect upon the COST OF CONSTRUCTION of such standards is calamitous in a high degree. The precise extent and limits of this disadvantage is, of course, an essentially indeterminate problem, nor has the writer space in which to prove it at length, even if he had the detailed data required. What momentous changes might have been effected in the general route under such a rational and scientific system of inter-adjustment; what short cuts might have become feasible which were wholly impossible under the Procrustean standard adopted; whether an important reduction in the equivalent ruling grade might not have been effected by using say 60 feet and 10° maxima instead of 84 feet and 12°—all these questions we cannot enter into in any way. But it is believed that no one familiar with railway construction in mountainous and difficult regions will question for a moment that if we may use such a graduated scale as that suggested, the cost of construction might be reduced at least 25 per cent. without deviating more than 600 or 800 feet from the present line at any point; after deducting from the economy effected, the capitalized cost of any difference in distance, curvature, and rise and fall.††

We give in a foot note below an approximate estimate of cost and quantities, so that any one familiar with construction can judge of the difficulties of the route under the standard adopted and the probable effect of such a system of location as that suggested.‡‡ In the writer's view, the economy effected might very probably have greatly exceeded the percentage above suggested, but the moral which it is designed to draw in no way depends on the *extent* of the saving, nor has he any desire to exaggerate its amount. Grant that it would have been only $1,000,000 in all, was it not worth saving, and *might* it not have been saved? Is it not time that these more important questions should be analyzed with that exact and

‖ For an appreciation of this latter (and generally unrecognized) fact, the writer is indebted to MR. ALBERT FINK, and if we might hope that any one would ever *thoroughly* investigate the action of *all* these forces, it might prove an element of much importance in the economy of curvature. How far and to what extent the tractive resistance varies with the action of the lateral forces is wholly a matter of conjecture; but with a train of 30 cars on a 6° curve + 60-feet grade, the lateral resultant from obliquity of draft is about 600 pounds immediately back of the engine, an equivalent for the lateral force which would be created by a super-elevation of about 17 inches. On the other hand, on a level grade this lateral resultant would be only about 180 pounds for the same train, equivalent to a super-elevation of about 5 inches. It is not probable that the *longitudinal* resistance varies in anything like this proportion, but so powerful a force, and such great differences in its amount, must at least have an effect of appreciable importance.

** See Journal Am. Soc. Civ. Engrs., October, 1876, p. 341.

††According to the tables we have previously given, the capitalized cost of any increase in these items was as follows, at $1.25 per train mile:

Distance, per foot, by Table A $0.92 per estimated daily train.
Curvature, per degree, by Table B, $4.35 per estimated daily train.
Rise and Fall, per foot, by Table C, $37.14 per estimated daily train.
On the other hand, the value per foot of any reduction in the rate of ruling grade was (by Table E) $6,686 per estimated daily train.

‡‡The total length of the Cincinnati Southern Railway is 336 miles, and the estimated or actual cost, in round figures, as follows:

Grading	$7,000,000,	or about	$20,700 per mile.
Tunnelling (over 5 miles in all)	800,000,	" "	2,400 " "
Truss bridges (over 2 miles) about	1,100,000,	" "	3,300 " "
Iron viaducts (nearly 3 miles) about	1,100,000,	" "	3,300 " "
Masonry	2,500,000,	" "	7,400 " "
Total	$12,500,000,	" "	$37,100 " "

The quantities per mile at average prices were:
Grading, 138,000 cu. yds. earth at 15c., *or* 23,000 cu. yds. solid rock @ 90c.
Tunnelling, 79 + lin. feet @ $31.
Truss bridges, 33 lin. feet.
Iron viaducts, 46 lin. feet.
Masonry, 740 cu. yds. @ $10.
That portion of the line, however, which we have been especially considering greatly exceeded this average: 25 out of 27 tunnels were concentrated upon it.

conscientious precision which is so freely bestowed on the petty details of structures. The economy and lightness of the gossamer-like fabrics which our modern engineers throw across great spans are by no means secured by making them poor and weak; but they are possible because every part of the structure has been made a separate study and is proportioned with scientific precision to sustain *exactly* its proportion of load *and no more than that.* In this way it is entirely possible to build both a *good* bridge and a *cheap* one; but the bungler knows no medium between Montreal and Ashtabula. Just so it is in location, except that errors, ten times as costly, are the rule instead of the exception, and—to any one who will look into the subject carefully—are ten times as gross and inexcusable.

Large versus Small Car Wheels.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have recently read in your paper articles instituting comparisons, in point of economy, between the chilled wheel and that with steel tire; and while the question is open for discussion it appears to me reasonable that something should be said in favor of wheels of a larger diameter.

The practice of using 33-inch car wheels is so general that perhaps an assertion that we have, during all these years, been making a very grave mistake may not readily be admitted, and yet a careful consideration of the subject and comparison with work on railways in other countries, coupled with experiment, will show conclusively that there is plenty of room for such an assertion.

Perhaps some of your many readers may be able to state why this small wheel originally came to be adopted as a standard in this country; but be that as it may, it is quite certain that the same kind of reasoning which induces us to use large wheels for fast traveling on our highways is applicable to railroad locomotion, and undoubtedly applied in almost every other country.

Great Britain has introduced our style of cars, both day cars and sleepers, with undoubted success, and it does appear that we shall yet, in return, be taught by her an excellent lesson in the matter of wheels.

Apart from the extra dead weight of our cars as compared with paying freight, caused chiefly by their extra length and peculiarities of our traffic, can we not trace much of the extra cost of working to this difference in the size of our wheels, not only in the car, but also in the permanent way department? My own belief that it is so must be my reason for writing you on the subject.

The average cost of working the car department of English railways for the half-year just ended was about 5 cents per train mile, and the cost of maintenance of permanent way about 14 cents; and notwithstanding the larger amount which is annually expended there for renewals, these figures are little more than one-half of the cost per mile on American railways.

I am assuming that a wheel of 42 inches in diameter (which is the standard of English railways) is the largest that can be used without raising the height of our passenger cars, and figs. 1 and 2 show the six-wheeled truck, commonly used under Pullman cars, adapted to this increased diameter.

The advantages in favor of the large wheel, briefly expressed, are as follows:

1st. The reduced cost of maintaining the permanent way. This will be readily conceded, when it is considered that not only is the bearing surface of the wheel upon the rail practically very materially increased, but that at a given rate of speed the 42-inch wheel makes 21 per cent. less revolutions.

2d. The saving in maintenance of wheels, with reference to the saving in operating expenses and the absolute immunity from accident caused by breakage.

The question, however, whether the wheels should be cast iron, or steel, or compound with centres of cast or wrought iron, is one to be solved by experiment only, and that of course to the satisfaction of the road using them; but it is important that if steel tires be used they should not be less than 2½ and if possible 3 inches in thickness.

Although undoubted success has been obtained from the use of steel tires on this railway, what is now advocated is the increased diameter of the wheel only.

HERBERT WALLIS,
Superintendent of the Mechanical Department
MONTREAL, Feb. 6, 1877. Grand Trunk Railway.

Fig. 1.

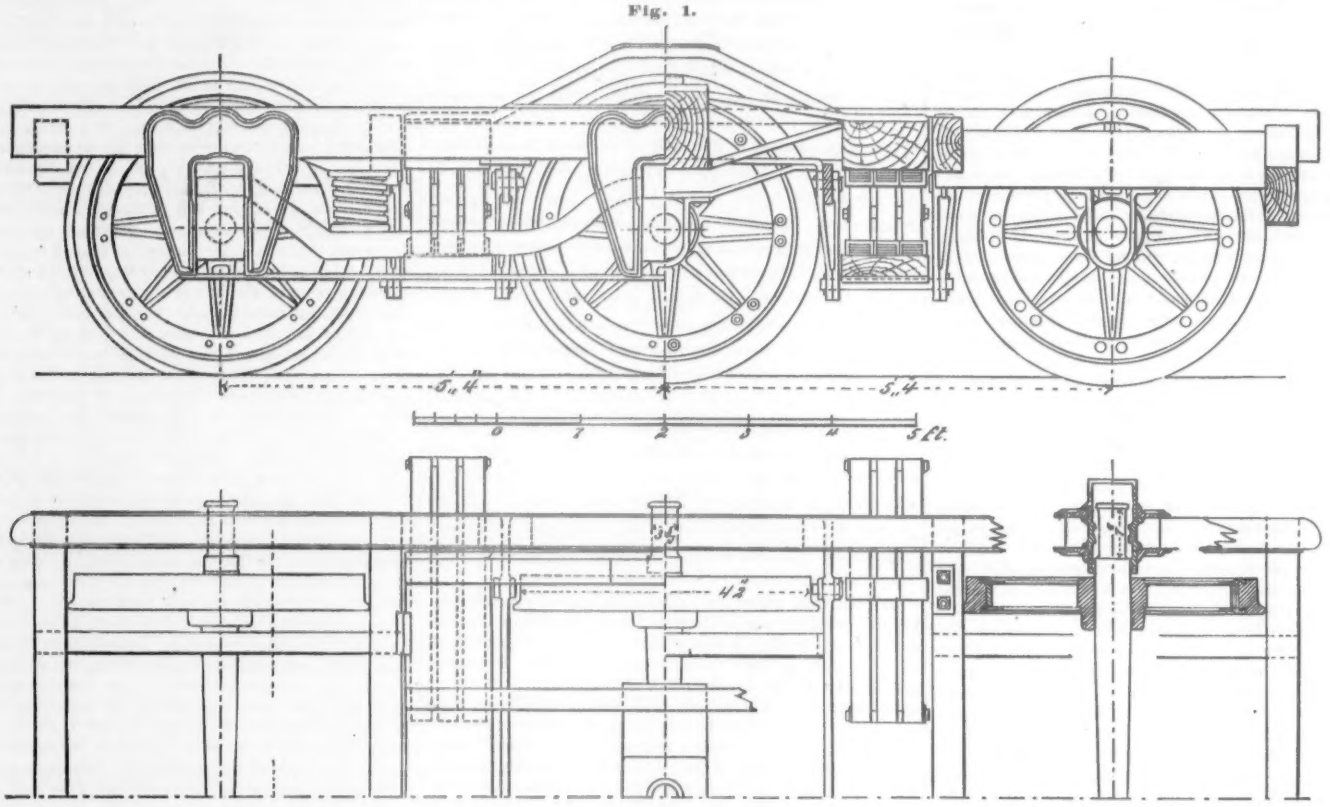

Fig. 2.

Steel and Iron Car Wheels.

BOSTON, Feb. 20, 1877.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There have appeared quite recently in your journal a number of articles purporting to shed light upon the much-vexed question of steel *vs.* iron as applicable to car wheels. Now while I had, by the aid of facts and data furnished by the proper officials of my road, formed a fairly favorable opinion of the steel-tire wheel, I found that my facts, which I knew were accurate and reliable, were very wide of what these plausible correspondents deemed perfectly fair assumptions and unimpeachable suppositions.

One writer placidly figured upon nineteen turnings of a steel wheel. Now if 1⅛ in. is the average amount which can be turned from an ordinary steel tire, whether it be solid with the cast-iron centre or loose and secured by bolts, then the *wear* on the wheel sufficient to render a turning necessary and *the turning itself* must remove from the circumference of the wheel only 0.0789 ($\frac{1}{12\frac{7}{6}\frac{8}{5}\frac{8}{0}}$) of an inch.

I have a feeling of deep respect for that railroad company the perfection of whose tools renders the supposition that this can be done not *once* merely, but *nineteen* successive times, admissible.

But Mr. Baker, a correspondent in your issue of Feb. 16, has, in his laudable endeavor to "show the case in its proper light," favored the public with some very curious examples of mathematical perspicuity and also of the generous spirit of some railroad managers. Six pairs of truck wheels are the usual number allowed an engine and its tender on the roads leading out of Boston; that is, there are two pairs under the forward end of engine and four pairs under the tender; but I find Mr. Baker's manager lavishly provides twelve pairs for this purpose; which is very thoughtful in the manager of course, but would, I should suppose, be rather embarrassing to the locomotive.

If Mr. Baker considered that the former articles had left the question in an unsettled and muddy condition, I certainly was not unreasonable in expecting that he would, in some measure at least, assist in removing the fictions and uncertainties which really surrounded it.

Mr. Baker furnishes a comparative table based on 45,000 per annum as engine and car mileage, and also as the average life of an iron wheel. The first pair of iron wheels, with their fitting, etc., costs him $27, and the first pair of steel wheels, with fitting (and he also includes *turning* at this point, although he had expressly stated they ran 135,000 miles *before* turning), costs $116.84 At this crisis he evinces some little nervousness, for he neglects to calculate any interest whatever on the first cost of *either* pair of wheels, for the first year, or until the first pair of iron wheels was assumed to be worn out.

After this peculiar precedent, the iron-wheel statement becomes so hopelessly entangled that I am unable to follow it; but its author, still faithfully clinging to it, finally emerges at the close of the ninth year with the sum of $179.31, which he evidently considers the total expense of iron wheels to run 405,000 miles, as he divides it by 405 to obtain the cost per thousand miles.

Notwithstanding this statement, he proceeds to add all the amounts for the nine successive years, giving $888.95, and deducts $10.00 for "old material." Whether this "old material" is nine accumulated pairs of wheels or only the *last* pair, or is some special provision not anywhere else referred to, I am utterly unable to extract from the communication. In either case your correspondent will have the opportunity of explaining why it was not deducted from the $179.31, and also the greater problem, why the progressive costs of the several iron wheels should have been added to make $888.95.

Returning to the steel wheels I see that after the first year interest is allowed on them, and it is computed very creditably indeed to the close of the second year; here, however, it appears to become affected by idiosyncrasies similar to its iron companion, and passes into incomprehensible confusion. At the end of the ninth year, the figures for the steel wheels read $194.30, from which he finds the cost per thousand miles for steel wheels as he previously did for iron.

Then we have a repetition of the mathematical sleight-of-hand performance of adding the yearly results and subtracting "old material," with a corresponding unintelligible remainder.

Learning nothing from a statement so eccentric as this one, I took your correspondent's figures of mileages, times, costs, rate of interest, etc., as nearly as I could determine them, and found that iron wheels (all due credit having been given) would cost at the end of nine years $213.98 against his showing of $179.31; and steel wheels for same period gave an expense of $196.97, against his $194.30, thus making, by my computation on his basis, a showing in favor of the steel wheels of $17.01, instead of the opposite.

But your correspondent goes beyond the statement and tells us that the average cost per year per engine for nine years for

chill wheels will be $1,171.92, so at this rate the cost of merely maintaining iron truck wheels under the 653 locomotives and tenders on the eight roads out of Boston will be no less than $765,263.76 per year. Now I learn from the Eighth Annual Report of the Board of Railroad Commissioners of this State that the total cost of locomotive repairs on these roads for the year 1876 is but $825,507.32, thus leaving $60,243.56 to cover *all the remaining repairs.*

If I had taken the figures he gives for steel wheels for one engine per year, I should have had a sum over $350,000 *more* than the total cost of engine repairs as given by the Commissioners.

But then the roads referred to may not have included in their estimate the six extra pair of wheels which Mr. Baker makes use of, and this would alter the result somewhat.

Toward the close of your correspondent's contribution this remarkable sentence occurs: "In engine service considered above, we would have to make 17 miles every hour of 300 working days, or 135,000 miles per engine per year," showing that your correspondent is in advance of most people in the matter of *time* as well as of truck wheels, for by this statement he has 26 hours and 28 minutes per day.

After the many difficulties so intrepidly encountered and withal so satisfactorily (to himself) vanquished, I am filled with admiration for the far-sighted diplomacy with which your contributor identifies himself and his argument with the wheel makers. Now, Mr. Editor, whether or not the iron-wheel men repudiate Mr. Baker and his statement as a whole, they cannot renounce his last paragraph.

And the iron-wheel makers, until chilled wheels shall have ceased to furnish a profit, will undoubtedly maintain their productions to be "the cheapest, safest and best yet invented."

FIGURES.

[It is but justice to Mr. Baker to say that before the above communication was received he wrote to us, saying that his letter was not intended for publication, and called attention to errors pointed out by our correspondent above. —EDITOR RAILROAD GAZETTE.]

Bridge Engineering.

TO THE EDITOR OF THE RAILROAD GAZETTE:

By giving to the public the fullest ascertainable particulars of the construction and failure of the Ashtabula Bridge, Mr. Philbrick has performed a service for which all bridge builders,

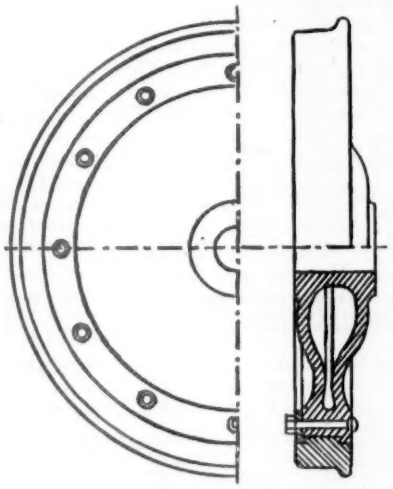

Fig. 4.

and all interested in bridge construction, should be truly grateful. His article is the first I have seen that fairly lifts the veil of mystery surrounding this great disaster.

The subject has called out many interesting communications from other engineers; but most of these writers have naturally, if unconsciously, used the occasion to ventilate their own peculiar views of bridge construction, rather than to account intelligibly for the failure in question.

This unconscious egotism is curiously illustrated in the letter of Mr. F. H. Smith. His hobby is "contracting engineers" and, incidentally, deep trusses and closed columns—all interesting subjects, and possessing certain merits, but, like most other subjects, capable of appearing in different lights from different points of view.

From Mr. Smith's point of view, the contracting engineer, "who don't do his own work," and he alone, can construct an ideally perfect bridge, because he can reject imperfect work without himself suffering loss. To the thoughtful, however, there would seem to be no sufficient reason why the exigencies of competition should not offer to the contracting engineer, quite as potently as to the manufacturer, temptations to be content with faulty design and insufficient material.

In deep trusses Mr. Smith finds increased rigidity; but a sound principle may be vitiated in practice by carrying it to extremes. To illustrate, the writer of this has personal knowledge of a bridge, constructed by a firm whose reputation for engineering ability and good workmanship has become national, in which the depth of truss is so out of proportion to its length that, until recently readjusted, the tension of counter and lower lateral rods was sufficient to reverse the strains in the lower chords, causing the bars in the centre panel to buckle to such an extent that the weight of a heavy locomotive was insufficient to straighten them.

Of course, the deflection of this bridge when fully loaded was very great.

Mr. Smith values the closed column, because in this form there is greatest economy of material: yet, from an economical point of view, may not the use of the closed column, involving as it does the cast-iron joint block, be attended by additional expense more than sufficient to cover the extra material required in other forms? and is not the preservation of material in the finished structure, through accessibility to all its surfaces for the purpose of cleaning and painting, a matter quite as essential as its economical distribution in the first instance?

In conclusion, it seems to your correspondent that the lesson taught by the Ashtabula disaster is, first of all, that we should cultivate the virtue of humility, and gladly profit by the failures of our predecessors without belittling the successes of our contemporaries; that we should bear in mind that our own estimate of any special merit in our own work will naturally be much higher than its true value will warrant; and that we should not ignore the probability that the bridge engineer, visiting our next centennial exhibition in search of knowledge, will look with wonder upon examples of even the best of our work of to-day as curiously antiquated if not unscientific.

J. LEE MARSH.

ATHENS, Pa., Feb. 16, 1877.

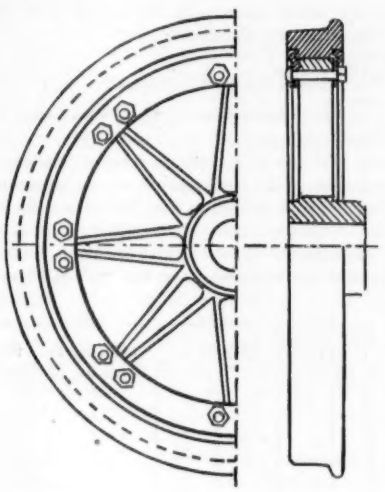

Fig. 3.

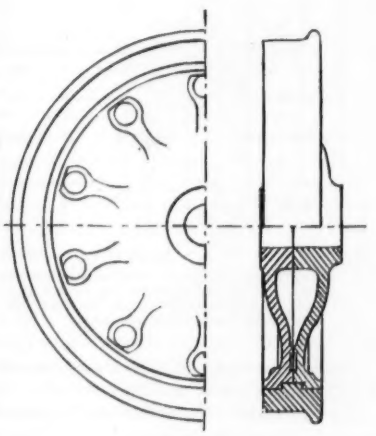

Fig. 5.

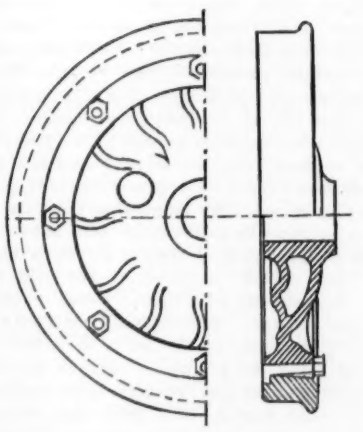

Fig. 7.

The Train Order and the Quincy Collision.

SACRAMENTO, Cal., Feb. 8, 1877.

TO THE EDITOR OF THE RAILROAD GAZETTE:

If it was the duty of the train dispatcher spoken of in "E. C. Centric's" letter published in your paper of Jan. 19 to prefix "After the arrival of C. B. & Q. No. 101" to his order to conductor Gale, it was equally binding upon him to call Gale's attention to every train he must meet on the order. That train was of no more importance and had no more connection with his order to "wild" than the second, third or last train he might be expected to meet; and if *it* was specified, consistency would demand that mention be made of all the trains on the time card. Consistency is a jewel in railroad business, and there can be no discipline without it. There is no practical reason why the words should *not* have been in the order. They could do nothing but good in this case, yet the dispatcher was strictly logical and deserves no blame for not treating the trainmen as if they were incapable or inefficient.

As long as orders are given by men and to men, they cannot be made *perfectly* safe, as the writer affirms this order would have been with his prefix. The conductor might need a notice in regard to the next train he must meet wherever he came up to its time, then the next, and so on.

There is every reason for conciseness and brevity in orders. Give the full and precise meaning in good English and no more. Any instructions or information not directly affecting the rights of the train tends to obscure the main purpose of the order, renders it more liable to escape the memory, and should be sent in a separate form entirely distinct from the order. Nearly every dispatcher has little tricks of language, developed by habit. His men know by experience what this twist or that means, while the letter of the order may be entirely innocent of any such construction. A few train dispatchers' conventions would help the country very much I think.

"E. C. Centric" says: "In the train order the attention of the men was called to but one train, entirely overlooking the other. Is it any wonder that a conductor who had never run a rain out of Quincy should have depended entirely on the order without consulting the card?"

The telegraphic order is not used to call attention but to *overn*. It is arbitrary and absolute, and it is no place to put outside references. The rights of the train mentioned in the order are entirely recalled, while the rights of C., B. & Q. 101 would not be changed in the least by the reference demanded.

It *is* a great wonder that men should depend entirely on their order, since the permission to "wild" is nothing more or less than "look at your card and avoid regular trains."

"E. C. Centric" says: "It does seem that as far as possible the system of telegraph orders and the time card should be kept as separate as possible, using both only when absolutely necessary. To me it hardly seems possible to run a lot of trains either by telegraph or time card, exclusively. The two have been so successfully combined and operated that neither will ever be suspended probably.

A delicious humor shines out in "Centric's" argument that the accident could not have occurred if the telegraph had been laid aside for the time and the men been compelled to rely entirely on the time card. Without the telegraph the train could never have left the side track and doubtless would have been safe from harm; but that is a rather expensive way to prevent accident.

N. O. ZELE.

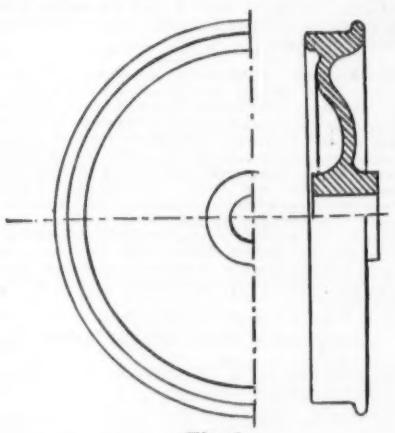

Fig. 6.

Railroad Manufactures.

The Missouri Car & Foundry Co., at East St. Louis, is building a number of box cars for the St. Louis, Iron Mountain & Southern road.

The King Iron Bridge Co., at Cleveland, O., is building an iron highway bridge of three spans, 175 feet each, to cross the White River at Bedford, Ind.

The Michigan Car Co., at Detroit, is building some box cars for the Erie. They are to have the Safford draw-bar.

The contract for the rails for the Waynesburg & Washington road has been let to the Riverside Iron Co., of Wheeling, W. Va., at $40 per ton. They are to be of iron, 30 lbs. to the yard.

At the recent annual meeting of the Joliet Iron & Steel Co., at Joliet, Ill., W. S. Brooks was chosen President and H. E. Bigelow Secretary. A committee of five was appointed to inquire into a proposition made to lease the works.

The Albany & Rensselaer Iron & Steel Co. reports its steel-rail mill as full of work; with a number of orders on hand to be filled.

H. S. Manning & Co. have been appointed agents in New York for the sale of the bolts, nuts, etc., manufactured by Hoopes & Townsend, of Philadelphia.

The Atlanta (Ga.) Rolling Mill is running full time with a full force on iron rails.

The Barney & Smith Manufacturing Co., of Dayton, O., is building 300 box cars for the Houston & Texas Central road.

The American Duplex Ticket Co., of New York, has had orders for duplex tickets of various forms from 25 new roads in the last four months. The Central Pacific is going to give the "Eureka" station ticket a trial, and the California Pacific is also going to try the ticket in book form for stations.

Wm. B. Bement & Son, of Philadelphia, have just completed a 6-inch bolt-cutting and nut-tapping machine for a Western rolling mill company. This is believed to be the largest machine of the kind ever built in this country.

Porter, Bell & Co., at Pittsburgh, have sold their Centennial engine to the St. Louis, Bloomfield & Louisville Company, and have also lately shipped shifting engines to a coal mine in Georgia and an iron mine near Altoona, Pa.

Wilson, Walker & Co., of Pittsburgh, have a contract for the draw-bars and truck frames for a large number of freight cars for the Pennsylvania Company.

Metcalf, Paul & Co., of the Verona Tool Works, near Pittsburgh, are negotiating for several orders for track tools to go to Germany and Brazil.

W. H. Baily & Co., at Connellsville, Pa., are building narrow-gauge engines for the Springfield, Jackson & Pomeroy, the Jonesboro and the Philadelphia & Atlantic City roads, and one of standard gauge for the Kansas City, Burlington & Santa Fe.

The Leetonia (O.) Tool Co. manufactures picks, mattocks and other contractors' tools, and is doing a steady business. The works are to be enlarged soon.

RAILROAD GAZETTE

Published Every Friday.

CONDUCTED BY

S. WRIGHT DUNNING AND M. N. FORNEY.

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Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

THE NEW YORK GRAIN CARRIERS.

We gave last week some account of the movement of grain to and from the Atlantic ports for a series of years, illustrated graphically. This week we desire to make some examination of the course of the grain movement by the different routes which supply New York. What are the lines by which that city receives grain; which are the more important to it, and which are losing and which gaining in their grain business? These are questions of more importance to New York than to other cities, not only because its trade is threatened, but also because it has two radically different connections with the grain-producing district—a water route as well as rail routes. Moreover, the railroads of New York do not serve it so exclusively as Baltimore and Philadelphia are served by their railroads. The New York Central & Hudson River Railroad carries chiefly (that is, of grain going to the seaboard) to New York; but it is also the chief carrier of Boston grain. The Pennsylvania brings a considerable amount of grain to New York, but it brings to Philadelphia substantially all that goes there, and it also carries to Baltimore — is indeed the shortest line to Baltimore for the largest part of the Northwest. The Baltimore & Ohio carries comparatively little destined for any other port than Baltimore. New York, too, is served by many routes; the other principal cities by few. Only the Erie Railway and the Erie Canal have New York for their sole grain terminus; but last year nearly half its entire grain and flour receipts arrived by other routes.

The basis of our examination, as last week, is found in the statistics compiled by Mr. E. H. Walker, Statistician of the Produce Exchange; and, as then, the quantities include grain of all kinds and flour and meal reduced to bushels. The period over which this study extends is seven years—as many years as the figures have been reported by the Produce Exchange.

The receipts for these seven years are illustrated by diagrams similar in every way to those published last week in illustration of the receipts at the different ports. Diagram 3 corresponds with Diagram 1 last week. The base of each parallelogram representing the receipts of a year is in proportion to the total amount received during that year, which is stated in figures above the parallelogram. The small rectangles within such parallelogram represent each the receipts by a single route, and their *areas* are in proportion to such receipts. Their *heights*, however, represent the *percentages* of the total receipts arriving by the routes represented. The figures on the left of these small rectangles represent percentages of the total New York receipts for the year; those on the right represent millions of bushels. Thus in the left-hand lower corner of the diagram, in the rectangle representing the receipts of grain at New York in 1870 by the Pennsylvania Railroad, the figures "7.2" to the right show that the Pennsylvania Railroad brought 7,200,000 bushels of grain to New York in 1870; and the figures "10.2" to the left show that this amount was 10.2 per cent. of the total New York receipts that year. The name of the route is indicated in the first and last years; but as they are necessarily much abreviated, we repeat them here in their order, from top to bottom:

Vessels coastwise.
Hudson River boats.
New York Central & Hudson River Railroad.
Erie Railway.
Other railroads not named (not inscribed on the diagram for want of room).
Pennsylvania Railroad.

During 1876 the New York Central & Hudson River Railroad forwarded a large amount of its grain over the last 100 miles from Athens to New York down the Hudson on barges. This is included in New York Central receipts on the diagram, though the figures are given for amounts and percentages separately for the "all-rail" and the "via-Athens" receipts. The latter are properly credited to the New York Central, as they are traffic which it secures for New York. The dotted line dividing the parallelogram for the receipts of each year sets off on its left the exports of the year from New York.

This, we think, will make plain the meaning of the diagram. Follow from left to right the small rectangles which indicate the receipts by a single route, and observe how they vary in width from year to year. The proportion of Pennsylvania receipts, after 1870, increases a little yearly until 1875, when it sinks sharply nearly to its starting point, and remains there through 1876. The receipts by "other railroads" (next above) are too small a proportion to be worth studying. The proportion of Erie receipts, beginning considerably larger than those by any other railroad, reaches its maximum in 1873, but does not vary a great deal, and ends a little higher than it began. But the New York Central, after 1870 (which was an exceptional year, shows uninterrupted and rapid progress. It brought to New York but 9.0 per cent. of its receipts in 1871; in 1876, no less than 30.8 per cent. And the proportion received by the Hudson River (substantially canal receipts) shows a corresponding uninterrupted decrease after 1870. New York received 58.6 per cent. of its total grain receipts by this route in 1871; in 1876, only 34.4 per cent. The coastwise movement is always small, but has varied in the seven years from 1.4 to 4.4 per cent. of the total.

The lower line bounding Hudson River receipts is the border between rail and water receipts. All below is rail, all above water receipts. Observe how regularly, after the downward step from 1870 to 1871, the rail receipts ascend. It is a staircase with an upward step for every year. Below we give a table showing the percentage of receipts arriving by each route for each of the seven years. The figures are the same as those on the left of the small rectangles:

Since 1871, then, the proportions arriving by water and by rail have been reversed exactly. In 1871 61½ per cent. of the whole arrived by water and 38½ by rail; in 1876, 38½ per cent. arrived by water and 61½ by rail. In the six years 23 per cent.—nearly a quarter—of the grain traffic has been transferred from the canal boats and coasters to the railroads. The total receipts for the whole period of seven years have been divided equally between the rail and water routes.

Further examination shows that the change is almost wholly due to the New York Central & Hudson River Railroad. The other railroads together brought to New York 29.5 per cent. of its grain receipts in 1871, and 30.7 in 1876. During the seven years the proportion brought by them varied from 29.5 in 1871 to 35.5 in 1873, and it was smaller in 1876 than in any other year of the seven except 1871.

	Pa. R. R.	Erie	N. Y. Cen.	Total rail	Hudson River	Coastwise	Total water.
1870	10.2	19.5	15.3	46.1	49.5	4.4	53.9
1871	8.4	20.5	9.0	38.5	58.6	2 9	61.5
1872	10.0	20.5	10.9	41.8	55.5	2.7	58.2
1873	10.8	24.2	15.5	51.0	47.6	1.4	49.0
1874	11.4	20.6	21.2	53.7	44.0	2.3	46.3
1875	9.3	23.5	24.3	57.6	40.3	2.1	42.4
1876	9.3	21.0	30.8	61.5	34.4	4.1	38.5
Average	9.9	21.4	18.1	50.0+	47.1	2.8	50.0—

A further illustration of the course of the receipts by rail and water is seen in Diagram 4, which corresponds in form with Diagram 2, published last week, and is on the same scale. It needs little explanation. The figures at the intersections of the lines indicate millions of bushels. The exports are also shown in this diagram. This shows quantities, not proportions. All our discussion heretofore has been of the *proportions* arriving by the different routes, the quantities varying, of course, with the total receipts of the city. There has been, however, comparatively little variation in these receipts since 1870. That year the receipts were much smaller than afterwards, and in 1874 the total receipts were much larger than the average; but for the other five years, the variations were only from 89,600,000 bushels in 1871 to 95,900,000 in 1876. The average for the seven years was 91,500,000 bushels. Meanwhile the total receipts at Atlantic ports, as we saw last week, have fluctuated greatly.

The above figures and diagrams show the relative rank of the different routes only as grain carriers to New York. Aside from the enormous traffic in shipments to interior points, which is especially large on the New York Central, as the chief carrier to New England and a chief carrier to interior New York cities, we have a large traffic to seaports of which no account is taken above. What the New York Central carries to Boston we have no means of knowing; but nearly all the Philadelphia receipts must arrive by the Pennsylvania Railroad, and these receipts last year

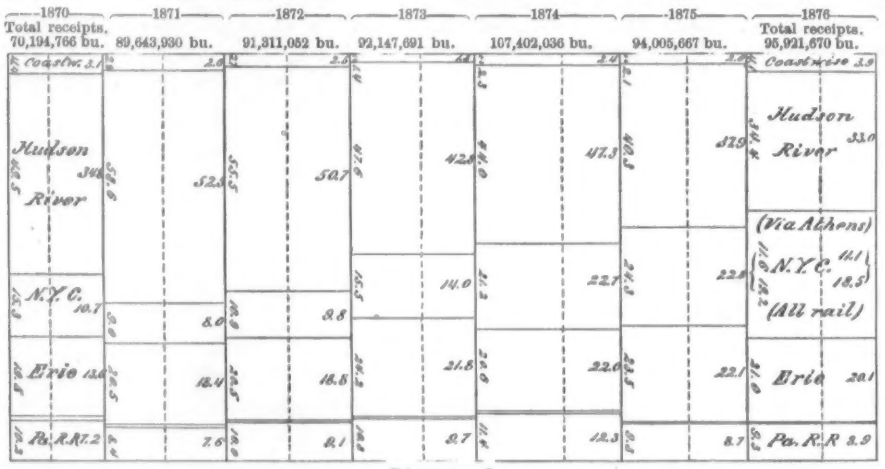

Diagram 3.

Receipts of Grain at New York by Different Routes for Seven Years.

[The parallelograms of equal height represent the receipts of the years named over them. Each of the small rectangles into which these larger parallelograms are divided represents the receipts by a single route. The figures on the *right* of such a rectangle represent the millions of bushels, and those to the left the percentage of total New York receipts arriving by that route.

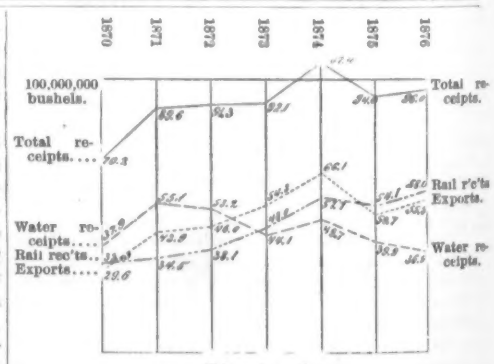

Diagram 4.

Course of Grain Receipts and Exports at New York.

[The figures at the intersections represent millions of bushels.]

were greater than the receipts at New York by any one route, either rail or water. Philadelphia receipts plus receipts at New York *via* Pennsylvania Railroad were 44,400,000 bushels, which is nearly one-half greater than the New York receipts *via* New York Central, and more than four-fifths of these latter receipts plus the whole of the Boston receipts. Moreover, the Pennsylvania Railroad carries a large amount of grain to Baltimore—how much, we do not know; but the total movement of grain and flour over this road to the sea-board is probably as great as that over the New York Central. The Baltimore & Ohio probably ranks third. The total Baltimore receipts (part of which arrive *via* the Northern Central) are about six million bushels less than what we have given above as the amount carried by the Pennsylvania to Philadelphia and New York. Probably, however, it is third only among the rail routes, the Erie Canal still surpassing it somewhat as a carrier to the seaboard. The movement by the Erie is doubtless pretty fully represented by the New York receipts by that route, as it cannot carry advantageously to any other port, or rather could not: its new connection with Philadelphia will make it possible for it to carry grain thither if it becomes desirable.

It thus appears that the whole burden of meeting the competition of other ports for the grain export trade has been borne by the railroads, and not by the canal; and that most of it has fallen upon the New York Central & Hudson River Company, which indeed was alone in condition to bear such a burden. The Erie has certainly done well to maintain its position. The water route alone has lost ground. If it had carried as much in 1876 as in 1871, New York would have secured 55 per cent. instead of 45¾ per cent. of the total receipts of the five leading ports.

Cost of Cast-Iron and Steel-Tired Car Wheels.

It will be seen from the columns of the *Railroad Gazette* that this subject is at the present time receiving special attention. At the last meeting held at the rooms of the Car-Builders' Association in New York, it was made the special order for consideration, and the facts brought out at that time will at least help to determine the relative cost of the service of the two kinds of wheels. The difficulty at the present time is, that there are still so many unknown quantities in the problem that it is necessary to a great extent to base the calculations which are made on assumptions, so that their results have only a hypothetical value. Discussion is, however, gradually eliminating the elements in the problem which are, or have been, uncertain, and the records which are now kept on several different railroads are furnishing information which is believed to be entirely reliable,

The report of the Pennsylvania Railroad shows that the average mileage of all wheels drawn which were no longer good for service was, in 1876, under sleeping cars, 56,523 miles, and under ordinary passenger cars, 39,650 miles. The fact that the service of wheels under sleeping cars was so much greater than under ordinary cars was, we believe, not even suspected before the record of wheel service was kept on the line referred to, and is an illustration of the way in which unexpected knowledge is often revealed by a careful record and analysis of data which seem to be of little value. The reason assigned for this difference in the service of the wheels under the two kinds of cars is, that the Pullman cars are all carried on six-wheeled trucks, whereas the trucks of the ordinary cars have only four wheels. On the six-wheeled trucks the brakes are not applied to the centre pair of wheels, so that one-third of the wheels under sleeping cars are not liable to be made flat by sliding. Besides, Pullman cars are run generally on through trains which make few stops, and therefore the brakes are not applied so often even to those wheels to which they are attached. By an examination of the record it will be seen that less than *nine* per cent. of the Pullman wheels were taken out on account of being flat from sliding, whereas nearly *twenty-one* per cent. of those under ordinary passenger cars were made unserviceable from that cause. It will also be noticed that the average mileage of the wheels which were "flatted" under Pullman cars was 28,134 miles, whereas those under ordinary passenger cars averaged only 18,859 miles. In other words, not only were more made unserviceable from this cause under ordinary cars, but they were made much sooner, and therefore averaged less than under Pullman cars.

There is a very slight difference in the weights which the wheels under the two classes of cars carry. The average weight of the Pullman car bodies on the road referred to is 37,800 lbs., or 3,150 lbs. per wheel. The weight of the ordinary standard passenger car body is 26,500 lbs., or 3,313 lbs. per wheel.

The great difference in the service of wheels under the two classes of cars should be noted by railroad officers and wheel manufacturers, because the former should require a much larger mileage for wheels under Pullman cars than for those in ordinary service, and the latter should be cautious about giving a guarantee for as much service under the one as under the other. This difference is also important in comparing the service of different kinds of wheels. An average mileage of 60,000 miles, according to the Pennsylvania Railroad report, would not be a very large service under Pullman cars, whereas 50,000 is more than can be expected under day "coaches."

The Lake Shore & Michigan Southern Railway's report of wheels does not give the number or mileage of those made flat by sliding. Whether these are included in the report, we are not able now to say. If they are not, it changes the relative values of the service reported and makes it necessary, in comparing it with the Pennsylvania Railroad report, to take the "total mileage of wheels worn out." These figures for the year 1876 were 61,649 as the average mileage under Pullman cars and 49,387 in ordinary passenger service. In estimating the cost of wheel service the wheels made flat from sliding should be included in making up the average, because, so far as we now know, these wheels are always paid for at their full price, it being assumed that the injury to the wheel from this cause is the fault of the employes of the railroad company and not of the wheel manufacturer.

The average mileage of all the 33-in. wheels, drawn from both Pullman and ordinary passenger cars on the Pennsylvania Railroad in 1876, and which were unserviceable, was not quite 45,000 miles. In December of that year it was over 53,000 miles, and we learn from a trustworthy source that the average mileage on that line for the first two months of 1877 will be considerably greater than it was during the previous year. It will therefore be seen that we are in a fair way of getting data, which will be entirely correct and reliable, showing the service performed by chilled cast-iron car wheels in passenger service. But before it is possible to determine with certainty which kind of wheels are the cheapest, we must have equally reliable data concerning the service of steel-tired wheels. At the present time we doubt whether this information is procurable in this country, and we have now no means of knowing whether records are kept in Europe with sufficient care to supply the needed data. In a recent article in a French journal, *La Revue Industrielle*, the writer gives the *average* mileage of 37-in. steel tires at only 124,000 miles. There are, however, evidences of some misconception or error on the part of the author or the compiler of the statistics, so that we are not inclined to accept the data implicitly without some further confirmatory information. If, however, 37 in. steel tires will not give a greater average mileage than 124,000, then cast-iron wheels will be very much cheaper than the former. We hope within a few weeks to procure some data from Europe which will shed some light on the service performed by steel-tired wheels there, and also to satisfy ourselves and our readers concerning some points in the reports of wheel service published last week which are not quite clear. On a closer study of them it does not seem quite certain that we can rely on getting an average service of 50,000 miles from 33-in. chilled cast-iron wheels in passenger service. If the Lake Shore report *does not include* the wheels made flat by sliding, then the average on that line will be considerably less than 50,000 miles for the past three years; but if, as seems probable, we can rely upon getting an average service of 50,000 miles from 33-in. cast-iron wheels, then the service of steel-tired wheels must be at least ten times as great to be as cheap as that of the former, so long as the difference in price is as great as it now is.

The Chicago, Burlington & Quincy Report.

The Chicago, Burlington & Quincy Railroad has held its position as a 10 per cent. dividend-paying road with remarkable success since the panic of 1873, while so many companies theretofore strong have had to reduce their dividends, or suspend them altogether. And this is in spite of the fact that the company extended its connections and especially its branches during the flush times of railroad building quite as much as most of its neighbors. Nor were these branches of exceptional value. Most of them formed natural connections of the road after they were built; but many of them must be unprofitable, even at the low rates at which they were acquired. The company, however, was exceptionally fortunate in its extension across Iowa, which, even before the consolidation, had secured a large and profitable traffic. It is also fortunate in its location, almost everywhere through a most productive country, well peopled in all the older parts, and growing rapidly elsewhere. Its location also makes it a favorable outlet for the entire railroad system of the country west of the Missouri and south of Omaha, as well as of the country due west of Omaha; and for most of the country on its lines and its western connections (to a less extent to its southwestern connections), it serves equally well as carrier to and from Chicago and the lakes and as a section of a through all-rail line to the seaboard. This gives it a great advantage over the lines which extend in a more southerly direction from Chicago. The southern stations on the Illinois Central, for instance, are about the same distance from the seaboard as is Chicago itself; and when shipments are made through by rail, as they are to a great extent when rail rates are about as low as water rates, the north-and-south road is a section of the longest line, and either does not get the business or receives a comparatively trifling sum for carrying it, for it is not in position to advance it on its way. The very great advantage of the roads extending westward from Lake Michigan is that they receive the traffic whether it goes through by rail or by water, and get full rates for it, whatever they may be.

The Chicago, Burlington & Quincy is one of the few roads that have increased their mileage since 1873 by the acquisition of roads then built but become bankrupt, or by the construction of new lines. Such action in these times is sure to be viewed with distrust by many conservative investors, who reason that it must be bad policy, from the fact that most such acquisitions prior to 1873 have been unprofitable. We have expressed our opinion on this matter heretofore. Because a lease at $1,500 per mile per year has been unprofitable we may not conclude that the same or similar property is not worth $500 per mile per year. And from the fact that a road ought never to have been built we may not infer that a connecting road cannot make any good use of it after it has been built.

In 1875 the Chicago, Burlington & Quincy Company made a contract for the lease of the 46 miles of the Quincy, Alton & St. Louis Railroad—a poor property, certainly, but worth more to the Chicago, Burlington & Quincy than to any other possible owner, probably. In 1876 it bought outright the 270 miles of the St. Louis, Rock Island & Chicago road, with its equipment and contracts for running over 37 miles more road. This was a very poor property, with light traffic and small net earnings; but it existed, was able to earn something, could earn more worked by the Chicago, Burlington & Quincy than as an independent road, and as a competing road did some injury to its richer rival; and it was bought for little more than the original cost of the rails laid on it. Probably this was the best use that could have been made of the road.

One very striking effect of the acquirement of properties of this kind is the reduction of earnings per mile, net and gross, of the buying company; but another effect quite as important is the reduction of the capital account per mile. Thus, before the acquisition of the St. Louis, Rock Island & Chicago road the securities of the Chicago, Burlington & Quincy per mile of road were:

Stock	$21,278
Bonds	21,203

By adding it, these amounts become:

Stock	$17,612
Bonds	19,147

though $12,500,000 of 5 per cent. bonds will be added to the funded debt as the result of the purchase.

This calls attention to the fact that it is not alone large traffic and earnings that have enabled this company to keep up 10 per cent. dividends in bad times, but also its small capital account. It required last year only $1,536 of net earnings per mile to pay the interest on its funded debt, while the total net earnings, though less than in previous years, were $3,880. Compared with the interest charge of most prosperous Eastern railroads, this is a trifling obligation; and the stock is only equal in amount to the debt. Yet this road, though most of it has but a single track, is one of the best built and best equipped in the country, provided with nearly all the appliances required for its traffic.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Henderson & Overton.—The first track is laid from Overton, Tex., southeast 5 miles.

South Pacific Coast.—Extended from Santa Clara, Cal., southward to San Jose, 5 miles. It is of 3 ft. gauge.

This is a total of 10 miles of new railroad.

ERIE SECURITY-HOLDERS held a meeting in London, Feb. 8, at which more signs of interest were shown in the proposed arrangement between stock and bondholders for an amicable foreclosure and a reorganization than have been manifested heretofore. This arrangement, it will be remembered, provides for an assessment to be paid by the stockholders and the funding of part of the coupons for several years of those bonds on which no interest is now paid. At this meeting great stress was laid on the fact that Mr. J. S. Morgan, of the banking house of J. S. Morgan & Co., had assented to the scheme, he apparently holding a large amount of the bonds. Sir Edmund Watkin, who presided, thought that the result of the last fiscal year under the circumstances was creditable to the Receiver. He said that, "so far as he could see, the great majority of the bonds would be deposited with them, and the great majority of the shares be paid upon." The opposition to this reorganization scheme is led by Mr. James McHenry, and it is remarkable that the objections advanced are that too great sacrifices are required from the stock and bondholders; whereas those most familiar with the road in this country are more likely to find fault because the scheme requires yearly payments for interest greater than the road may be able to earn at present. By the way, under this scheme a coupon of the first consolidated bonds was to be paid March 1, requiring more than $420,000; though, perhaps, no endeavor will be made to pay it until there is greater assurance that the scheme will be carried out and the stockholders pay their assessments. At least we have heard of no application to the court to permit such a payment, and we believe that a special order is required before it can be made.

THE PERSPECTIVE VIEW OF THE ASHTABULA BRIDGE, published in the *Railroad Gazette* last week, as should have been stated at the time, is one of the engravings to be contained in the elaborate report of the coroner's inquest, which Mr. J. M. Goodwin is preparing. That report will contain, further, an isometrical view of the bridge as actually erected, details, strain sheets, a diagram of the position of the wreck, and other engravings illustrative of the structure and the manner of its failure.

A FREIGHT AGENTS' MEETING was held in New York, Feb. 27, to consider the trunk-line tariffs for exports, etc., but neither the Pennsylvania nor the Baltimore & Ohio was represented, and an adjournment was had until March 1—after we go to press. It seems that there continue to be differences of opinion as to the interpretation of the managers' agreement of Dec. 16, and it is possible that there will have to be a managers' meeting before the matter is settled.

THE PACIFIC RAILROADS FUNDING BILL, which has been under discussion in the Senate a great part of the session, was postponed until next December by a vote of 29 to 28 last Tuesday, the friends of the law favored by the comp nies voting against the postponement. It may at least have the advantage that before a new law is passed there may be a decision of the Supreme Court which will declare just what the companies are required to pay under the law as it stands.

THE CHICAGO & ALTON REPORT for 1876 has just been published, but as yet we have only a telegraphic summary, which makes a very good showing indeed. Receipts were $5,087,114 and working expenses $2,804,290, against receipts of $4,656,764 and expenses $2,604,125 in 1875. The increase in net earnings was thus about $230,000, or 11 per cent. The telegram gives the surplus above interest and other charges as equivalent to 9 per cent. on the stock. Eight per cent. dividends were paid.

Contributions.

Butted Compression Joints, the Articulate Form of Bridge, and the Contracting Engineer.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It must have been evident to any reader of this paper that, in the treatment of the relative merits of a certain class of bridges that are made in this country, and the class of riveted bridges, about all the articles that have appeared have been on the one side only—that of the first named. And by the use of such enticing terms as "American" and "pin-joint," a species of blindness to all the other attributes of the articulate form of bridge has been created and nurtured in portions of our community, and, in the case of some polite and well-entertained guests, has spread to some foreigners also. And it would undoubtedly be a great deal easier for anyone to swim with this current, simply make use of some such phrase as the well-worn one—"Our American style of bridge, so superior to the European form," whatever that may mean, and theorize about quibbles on the one side and the other, than it is to "call a spade a spade," use your judgment, and take a broad and untrammeled view of the whole subject, past, present and future, far and near. But I never did believe in idol-worship, nor in Procrustean beds, more especially in the arts and sciences; the first as revolting to my reason, the second as interfering with the personal liberty of the skillful constructor; and as you have got me into a discussion with engineers, Messrs. Editors, by reprinting the article that appeared over my name in the Boston *Daily Advertiser*, I do not mind taking up the cudgels in behalf of the cause that seems just to me. At all events, it would seem to be no more than fair towards myself that I should speak in professional terms, and endeavor to so describe my position that I may not again be misquoted.

I might say something also on the subject of motives in writing, about which we have been favored with sundry disquisitions in your paper; but we will let that pass. I suppose I write because the rest do; why they do, I never could find out. But they do; and a certain number have been saying various things in favor of what they are pleased to term "pin-jointed" ridges, and derogatory to a creation of their individual minds hich they term "lattice," or "riveted," and sometimes that name reeking with the odor of "the effete monarchies of Europe," "European," in distinction from the patriotic appellation of "American." Now, the position I endeavored to take and make clear in the article of mine reprinted as above, was simply this: That the name pin-joint is not a correct term to be applied to bridges, in which a comparatively limited number of joints only are of that particular kind, while the many others, in the main trusses, the cross-girders, lateral bracing and their various attachments among themselves, are of a different kind, and may be detrimental to the stability, life and wear of the whole bridge. In fact, *it is principally these other joints that give character to the whole bridge;* whether it is to be classed as best, mediocre, or worst of its kind. And there are many qualities of these so-called "pin-joint" bridges. They differ in ways of which, ordinarily, little or nothing is ever said; their precise points of difference are overlooked by all but the closest of expert examination. Between the best and the worst specimens there is a wide difference mechanically, a great difference in value, a very slight difference in general appearance or popular reputation, and they all pass by the name of "pin-jointed bridges," and would deck themselves with the honor of being "American." They are composed of many pieces, joined in a manner that does not cause any one piece to lose its identity in that of the whole structure, the whole bridge existing under a sort of a confederate form of government. I do not think of a name that would clearly express this prominent feature in their constitution, and shall for the present speak of them as articulated bridges. They are articulated, more or less, in a great many directions. The top chord is an articulated member, composed of many short lengths, or units; the bottom chord is the same, the various members of the diagonals, the cross-girders, lateral bracing are so many separate units or members, articulated among themselves and to one another. The same characteristics, including the pin-joint, existed in some of the earliest forms of foreign iron truss bridges that we know of, and have been repeated at intervals, at home and abroad; on the other hand, many bridges built in the United States, many recently built and building by American engineers and contractors, are riveted bridges. Hence, why call the first "American," neither invented here, nor used nor built here to the exclusion of all others? The credit of American builders has been to build this kind, articulated bridges, of a longer span and more perfect execution in a large number of instances, than ever done before. And all this has been done within the past ten years. But whether it was a wise move to go to the great expense necessary to build up shops and the very perfect machinery absolutely necessary for the purpose of building this one class of bridges, if that is to be done in a manner approaching a proper degree of perfection,—machinery that is hardly serviceable for other purposes,—is very much a question, and may be answered in a decidedly negative manner some years before the next decennium will have passed away.

It would seem to be scarcely necessary to point out to engineers what constitutes a riveted bridge; and yet there is apparently some misapprehension about it, at all events in the column of communications in this paper. It is simply a bridge, *all* of whose joints and connections are formed by rivets. This makes of the bridge one united whole and one essentially differing from an articulated structure. It is a most curious misrepresentation to speak of riveted bridges as having necessarily trough-shaped, or any other one kind of shaped chord or chords, or as having just such a system of webbing and no other, when the chords may be, and have been, made as widely differing in shape as those of the English tubular monstrosities and those of Calcott Reilly's super-carefully centred chords, and the other parts of the bridge form a variety of structure literally "too numerous to mention." I can not go into detail in all these matters at this time, but must reserve them for another occasion. But having now spoken somewhat on the point as to what constitutes an articulated and what a riveted bridge, I come back to the one grand test that this latter class of bridges has so nobly withstood for the past 30 years, and which is sufficient to cover a multitude of small theoretical counter considerations. I allude to the fact, so far as I know, and so far as seem to know a great many of the most prominent engineers of this country, that there is no single instance on record, in the whole 30 years that have elapsed since riveted bridges were first built, where a riveted bridge has failed from any causes directly or indirectly due to the riveting. And I call this a so thorough vindication of the advisability of making the joints and connections of a bridge by riveting, that all the shop and laboratory experiments on the strength of riveted joints to resist tension, or compression, or shock that can be made, can not prove this method of forming joints a bad one, or aught but an extremely safe one. There may be a question about the expense involved, but I have not come to this part of the subject yet. We are now discussing mainly a question of safety. On the other hand, I find, and many engineers have, since my letter above alluded to, found for me, a great many cases where iron bridges have failed from causes clearly due to their articulation, and which bridges would not have failed, in my opinion, had their joints and several connections been made by riveting. Take the late bridge at Ashtabula, for example, which, it is pretty well acknowledged now, did fail primarily at some panel point or joint, just as concluded in my letter of Jan. 24. I submit to those conversant with the behavior of such work, that had all the joints fore and aft and athwartship, and up and down in even that miserably designed bridge, been made by the usual forms of riveted joints or connections, that then that old man-trap would either be standing yet, or would have given warning of its failure in time to take it down. Or, starting out to build a riveted structure, the whole bridge would have assumed an entirely different composition and constitution, and judging by the past, would probably have stood until worn out and removed at least, just like all the other riveted bridges that ever were built, except that one in Peru, described in your paper of Jan. 2, 1875, and referred to in a recent number. And this brings me to that structure. It seems that it failed, as is clearly stated, by the buckling of the very peculiar end inclined struts, designed, it would seem, by some one mad on the subject of centralized pressure on struts. Query: What has the making of riveted joints to do with this? Would this bridge have failed any less had the joints been articulated? or would the end struts, being then hinged at both ends, not have yielded a shade sooner and easier? As I have reliable advices from there that this bridge was painted with red lead when it left England, it might be shown by a similar course of reasoning that this is a clear case of failure of a bridge painted red, and that the red lead did it. And I will there leave the Peruvian case.

Next consider, if it please, the oft quoted case of the bridge across the Hudson at Albany. A first-class articulated bridge; a train or car off the track knocks out one post, and nearly knocks out the next one to it. Being a double intersection truss with tolerably deep upper chords, the truss does not fall, but is held up on one edge or corner of the second post mentioned above, and the leverage of the chord in, or against, the joint-box.

I would ask, why should not the facts as stated above be quite as eloquent to engineers for all the purposes of teaching a lesson, as though the bridge had fallen into the river, and killed a hundred people in the fall? Does there not seem to be something wrong about articulating post connections and top-chord connections, and will calling such a bridge a "pin-joint" bridge save it? Other cases of failure of articulated bridges, I must reserve for a future occasion. At Oriskany, on the New York Central, the half of a freight train ran into the end post of a ridge, all of whose joints and connections were riveted, another name and form for clinch-fastened. It was severe on the car and split it through, as I am informed. It bent two panels of the bottom chord and the end post; they put a "horse" under the second panel point and went on using the bridge. Does there not seem to be a little advantage in having small railroad bridges, more especially, riveted throughout, or at least in compression joints? And again, I reserve the mention of other such cases, of which I have one more at date, for a future occasion. It is not unreasonable to suppose that in the past thirty years many such have occurred, and engineers will do the profession a service, if, rather than theorize about it, they will produce a case where a riveted bridge has been knocked down by having a derailed car or train knock a post or chord out. Quite a string of cases can already be produced where the articulated form of joint solely and simply was the cause of the bridge being knocked down, hence no need of calling for more cases of this kind. Which form of *compression* joint is the best?

And now we come to the most curious part of all. Riveted bridges are made to-day at quite as low, if not a lower figure, than the articulated kind, both of the same quality of their kind. Relative *weight*, so much laid stress on, is not the only thing to consider. It is also a question of *cost per pound*; whether it pays to buy 10 pounds of sugar at 11 cents a pound, or 8 pounds of sugar at 15 cents per pound, when, to put it mildly, the 10 pounds have no less saccharine qualities than the 8 pounds at the higher cost? Here again, it will be impossible to go into the reasons for this state of the case, at this time, relative cost of the shapes of iron used, cost of the labor, etc.; it is simply a fact, that for the ordinary cases of bridges, under say 250 ft. span, the total cost of the two kinds, just now, if not heretofore perhaps, is in this country less for riveted bridges than for articulated ones. Special cases want, of course, a special treatment; large spans are largely influenced by their own weight; bridges shipped to be put up in foreign countries, or in the "wilds of the West," if you will, are put up under exceptional circumstances; some rivers may require especial humoring; we are not now, and cannot always be, considering any such especial circumstances. Were the cost less for an ordinary bridge, when articulated than when riveted, a case would be made out, to a certain extent, against riveted joints; as it is, I shall not regret or modify what I have said against certain qualities of articulated bridges.

Mr. T. C. Clarke says (*Railroad Gazette*, Feb. 15): "For example, Mr. C. Herschel should appear before them [a commission] and maintain that no pin-connected bridges are safe, and nothing but riveted work ought to be allowed. Mr. F. H. Smith, on the other hand, would defend his views with that ability which he has often showed before, etc." Perhaps the first named gentleman ought, might, could, would or should appear and state as quoted, but I don't think he will. He will say not one word against "pin-joints," except possibly the item of their cost; but he would, with his present information, be forced to take definite position against butted compression joints, against shallow cast-iron joint boxes, to a lesser degree against deep ones also, against the utility of articulations wherever the experience of thirty years has shown a riveted connection entirely safe, economical and durable, and there seems to be no especial call for anything else, while to desert that form is evidently not unconnected with danger. He would urge such views with more especial reference to the ordinary everyday cases of railroad bridges, and if Mr. Fred. H. Smith would trot out, as he does in the *Railroad Gazette* of the week before, and talk about "tacking" diagonals to "trough-shaped chords" as descriptive of all riveted bridges, I shall think that he is not only going "too fast," but also too irregularly, and if the commission [if there is to be such a one: I hope not] will let me "handle the ribbons" over him for a little while, I think I can bring him down to a more even and a healthier gait without much difficulty, or objection on his part.

I propose to dispute with no man of the profession, as to how the business of building bridges should be conducted. These are matters of ethics, and of inner individual opinion. My remarks on this topic were addressed to the public solely; but I ought to explain, that when writing the article reprinted, I did not think of the class of bridge-builders represented and defended by Mr. Smith at all. And now that Mr. Smith has drawn their picture, what have we but our old acquaintance, "the middle man," in a new shape?

I suppose that there is a reason for their existence, or they would not exist; but for all that I do not see why the body politic should not be able to get along without them. They are the nicest kind of people to meet—bright, smart as a steel trap, pleasant; but what a competent Chief Engineer of a railroad, or of a city, for example, wants of them is more than I can imagine; and if he is so overworked as not to be able to give to the bridge-building part of his duties the attention which it deserves, why not have the skillful bridge-designer just mentioned about him all the time, and engage him at a proper salary; and if he wants to do so, and the directors, or city government will not let him, I do not see but that that article of mine of Jan. 24 was calculated to perform as good missionary service as is the devout hope of the writer it may do. I have the honor to hold to the opinion that bridges should not be built by gentlemen who perform the duties both of the contractor and of the engineer—any more than I believe that an architect should be the contractor for his designs, or believe that city water-works, or systems of sewerage, or a hundred other works of engineering which might be mentioned, should be built in the manner and by the class of hermaphrodite beings described. This is simply my opinion, and one which I expect the whole United States will come around to after a while, just as certain portions of it have already; and being a matter of opinion and State policy only, I shall not quarrel with any one of a different view, but only stand up for the right of free speech on the matter. This view seems to operate against the aforesaid "middle men," for which I am sorry. I did not think there were such when I spoke first; but I do not understand that the character of any man, or men, was, or is, assailed by the promulgation of such an opinion, or that

there is a strong feeling in favor of the continuance of such practice among the manufacturing bridge-builders. The only ones who might momentarily act as obstructionists in this direction would be such as would allow themselves to be misled by motives of catering to the demands of the stock of tools on hand, unfitted, perhaps, for aught but one class of work only. And to such, I have a final word to say. It is pretty well established in the history of bridge-building that the tubular bridge at Montreal was born of the insatiable desire of that huge Jaquard plate-punching machine at the "Canada Works, Birkenhead," for more food to chew on; somewhat also, we must infer from the constitution of human nature, from the fact that this was Robert Stephenson's pet style of bridge, made in his own works, in which no duck could be hatched out but it needs must be a swan. Now, are we to see any of this kind of influences take a hand in shaping the progress and unwritten history of bridge-building in the United States? Gentlemen, I hope not. There are many indications that the engineers of the United States are not and will never be the blind followers of any one style or form or class of bridge for all places and for all purposes; the great public are rapidly appreciating this feature, and understanding it, and the quicker you drop the patent-article-manufacturing style of building bridges, and announce yourselves in readiness to build the free untrammeled designs of engineers, any kinds and all kinds, the better it will be for the bridge-building interests of the whole country.

CLEMENS HERSCHEL, Civil Engineer.

BOSTON, Feb. 23, 1877.

The Advantages of Large Car Wheels.

The following paper was read at the February meeting of the Master Car-Builders' Association, but omitted from our report last week for lack of space. It will be interesting in connection with the letter from Mr. Wallis, published also this week:

To the Master Car-Builders' Association:

GENTLEMEN—While discussing the relative merits of steel or steel-tired wheels as compared with the chilled wheel in ordinary use, would it not be well to consider the subject of diameters in connection therewith? Although the subject to some may be comparatively new, yet there is a deep interest being manifested by many of our prominent railroad men in relation to this subject. There are many features of economy that present themselves to our notice in the use of a larger diameter of wheel, among which are the following: Less wear and tear to the rolling stock, rail and road-bed; less friction on the journal and wear of brasses; less motive power required to haul the train; more safety in their use, making less revolutions.

Perhaps the greatest saving is the great reduction in *cost* of using larger wheels. Taking as comparison the difference in mileage of a 26-in. wheel with that of 33 in. and computing the same with a 42-in. wheel, allowing the advantage gained by the increased diameter, we find a 42-in. wheel under the same equipment will make fully two and one-half times more mileage than a 33-in. wheel. With this fact established we have but to find the difference in cost between the price of the old wheel worn out and the new wheel, and we find a very great saving in the use of 42-in. wheels, probably reaching from 30 to 40 per cent. in the service of the wheel alone.

It has been fully demonstrated from carefully compiled records from several of our first-class roads that in the life of a 33-in. *chilled* wheel under their passenger equipment, they will make a *general average* of 55,000 to 60,000 miles.

The mileage of 42-in. wheels being two and one-half times that of 33 in., or 137,000 miles, and the first cost being ($24) twenty-four dollars, and value of old wheel worn out eight dollars, makes a total cost of sixteen dollars per wheel for 137,000 miles run, which gives us the extremely low figure of 11.7 cents per one thousand miles.

It appears from these facts that no steel, wrought-iron or combination wheel of steel and iron can be made that will be so economical in service as the solid cast-iron chilled wheel.

With these suggestions the subject is worthy of careful consideration. Much might be said in regard to saving of brasses, as it is a fact that no bearing has been known to heat with a 42-in. wheel on the axle, since their introduction into this country. The famous fast trip across the continent to California was a remarkable test of their superiority. The heavy hotel car had 42-in. wheels under it, and the boxes were not oiled during the trip, and it did not heat; while the car using 33-in. wheels had an arrangement for oiling the boxes from the inside of the car, and they were frequently oiled to prevent heating.

The easy motion from using large wheels should commend them as a means of prolonging the life of the rolling stock, while the extra leverage must be able to decrease the motive power required.

Much has been said and written about finding the best method of reducing dead weight on our trunk lines, where freight is carried at such extremely low prices. Have we not a solution of this problem by making our cars a little stronger, increasing the diameter of the wheel, and carrying fifteen or twenty tons? As to the strength of a 42 in. *chilled iron* wheel, we have but to refer to the past few years, when very many 48 in. and 54 in. solid chilled *driving* wheels were used under locomotives, where the service was much more severe.

Our opinion is, from practical experience, that a 42 in. wheel is stronger and safer than one of smaller diameter. It will work better in a four-wheeled truck than in a six-wheeled truck, as probably any other size would do the same.

We advocated the large wheel to save using the six-wheel truck, but find many railroad officers prejudiced (and perhaps justly) in favor of a six-wheel truck. They claim it is less liable to leave the track from broken rail or broken axle. There is no question about the extra friction in curving a six-wheel truck, and with the extra leverage in the 42 in. wheel over the 33 in. preference should be given to the 42 in. wheel in curving, whether it be six or four-wheel truck.

The question is constantly arising, "How can we reduce the cost of maintaining our rolling stock in connection with tonnage and miles run?" Can we do more in any other direction than that of reducing the wheelage account? A careful consideration of this subject has resulted in our firm conviction that a saving of over 30 per cent. may be made in our wheelage account *alone* by the use of 42 in. wheels.

Yours, very respectfully, WM. W. SNOW.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Marietta & Cincinnati.—At the annual meeting in Cincinnati, Feb. 21, the old board was re-elected, as follows: R. M. Bishop, George Hoadly, James D. Lehmer, W. W. Scarborough, Cincinnati; Wm. T. McClintick, Wm. Waddle, Chillicothe, O.; W. B. Loomis, Marietta, O.; J. N. Camden, Parkersburg, W Va.; Wm. F. Burns, Robert Garrett, John King, Jr., John Donnell Smith, Thomas Whitridge, Baltimore. The board re elected John King, Jr., President; Charles P. Low, Secretary and Auditor; W. T. McClintick, Treasurer; W. E. Jones, Registrar; W. W. Peabody, General Superintendent.

Illinois Railroad and Warehouse Commission.—The Governor of Illinois has appointed, and the Senate confirmed, as Commissioners Wm. M. Smith, a prominent farmer of McLean County; Geo. M. Bogue, a merchant of Chicago, and John H. Oberly, publisher of the Cairo *Bulletin*.

Boston & Albany.—The Massachusetts Legislature has chosen as State directors Francis B. Hayes, of Boston, and D. N. Skillings, of Worcester.

Indianapolis & St. Louis.—At the annual meeting in Indianapolis, Feb. 21, the following directors were chosen: C. C. Gale, Indianapolis, Ind.; J. H. Devereux, H. B. Hurlburt, Cleveland, O.; Thomas D. Messler, Pittsburgh, Pa.; Thomas A. Scott, Philadelphia. The board re-elected H. B. Hurlburt, President; Edward King, Secretary and Treasurer; Russell Elliott, Auditor.

Clay Centre, Hanover & Beatrice—This company was organized at Hanover, Kan., recently, by the election of the following directors: John Higinbotham, P. Rothman, J. H. Pinkerton, Clay Centre, Kan.; Wm. Kalhoefer, Dr. Lewis Moll, Hanover, Kan.; G. Schaubell, Fancy Creek, Kan.; S. N. Hazen, Blue Spring, Neb.; R. B. Harrington, C. M. Hill, E. Mack, Beatrice, Neb. The board elected Wm. Kalhoefer, President; C. M. Hill, Vice-President; Dr. Lewis Moll, Secretary; John Higinbotham, Treasurer.

Utica, Chenango & Cortland.—At the annual meeting in Cortland, N. Y., Feb. 14, the following directors were chosen: J. S. Squires, F. E. Knight, Chauncey Keator, Horatio Ballard, H. F. Benton, J. C. Carmichael, Cortland, N. Y.; P. H. McGraw, O. A. Kinney, McGrawville, N. Y.; George L. Cole, Cincinnatus, N. Y.; Ralph Taylor, Pitcher, N. Y.; Lyman Peck, Jr., Solon, N. Y.; J. W. Phelps, Taylor, N. Y.; H. V. Poor, New York City. The board elected P. H. McGraw, President; J. C. Carmichael, Secretary; J. S. Squires, Treasurer.

Mt. Sterling.—At the annual meeting in Mt. Sterling, Ky., Feb. 15, the following directors were chosen: H. E. Shawhan, C. W. West, J. Q. Ward, Cynthiana, Ky.; J. M. Vanarsdell, Menifu, Ky.; J. M. Bent, C. J. Glover, O. S. Tenny, Montgomery, Ky. The board elected J. M. Bent, President; J. Q. Ward, Vice-President; J. W. Jordan, Secretary.

Portland & Ogdensburg.—The new board has elected S. J. Anderson, President; Charles H. Foye, Clerk; J. W. Dana, Treasurer.

Ohio & Mississippi.—Mr. R. J. Williams has been appointed Division Freight Agent of the Springfield Division, with office at Springfield, Ill., in place of C. W. Willis, resigned.

Northern Central—At the annual meeting in Baltimore, Feb 23, the following directors were chosen: Thomas A. Scott, S. M. Felton, H. M. Phillips, Wistar Morris, George B. Roberts, Edmund Smith, J. N. Hutchinson, D. Noblit, Jr., Philadelphia; Wayne McVeagh, Harrisburg, Pa.; George Small, S. M. Shoemaker, M. B. Sellers, Baltimore. Messrs. Phillips, Roberts, Smith and Noblit are new directors, replacing M. B. Grensfelder, R. Oppenheimer, H. P. Borie and J. C. Bullitt. The Board re-elected Thomas A. Scott, President; A. J. Cassatt, Vice-President; Robert S. Hollins, Secretary; Stephen W. White, Assistant Secretary.

Pittsburgh, Cincinnati & St. Louis.—Mr. A. D. Kelley, formerly chief clerk in the general baggage office, has been announced as Acting General Baggage Agent, vice Shackelford, deceased.

Hannibal & St. Joseph.—Mr. Joseph Richardson has been chosen President, in place of Wm. H. Neilson, resigned.

Lehigh Coal & Navigation.—At the annual meeting in Philadelphia, Feb. 27, E. W. Clark was re-elected President, with the following managers: Francis R. Cope, Francis T. Yarnall, Fisher Hazard, Charles Parrish, Charles Wheeler, Geo. Whitney, Alexander Biddle, John Leisenring, Jas. M. Willcox, Edward Lewis, T. Charlton Henry.

Atlantic & Great Western.—Mr. Robert French, C. E., is appointed Roadmaster of the 11th and 12th Sub-divisions, with office at Niles, O.

Empire Transportation Co.—Mr. C. H. Rockwood is appointed Agent at Olean, N. Y., in place of F. B. Humphrey. Mr. F. B. Emery succeeds Mr. Rockwood as Agent at Corry, Pa.

Wabash.—The following circular is issued by Hon. J. D. Cox, Receiver: "The Wabash Railway Company has been fully organized as a consolidated company in Ohio, Indiana and Illinois, with the following board of directors, viz.: James A. Roosevelt, President; Solon Humphreys, Cyrus W. Field, Morris K. Jesup, Henry Crawford, Elisha Coray, John S. Kennedy, John W. Ellis, John T. Martin, George I. Seney, W. B. Isham, H. A. V. Post, E. H. R. Lyman. In accordance with the indications of the circular of Jan. 1, 1877, the duties of the undersigned as General Agent and Manager in the interim for the purchasers have ceased, and the proper officers of said company have assumed full possession and control. The business of the receivership of the assets, etc., of the Toledo, Wabash & Western Railway (the old company) will be completed by the undersigned in accordance with former notices, through the regular accounting and disbursing officers of the Wabash Railway Company."

President Roosevelt issues the following order: "Mr. A. L. Hopkins has been duly elected General Manager of the Wabash Railway Company, and will have authority and control of the railway and property of said company, accordingly. The other executive and administrative officers of said railway will be continued in their powers and duties till further notice."

Mr. Hopkins has been for some time past Receiver of the Toledo, Peoria & Warsaw.

Indianapolis, Lafayette & Bloomington.—The officers of this new company are: John W. Heath, President; John Bixler, Secretary and Treasurer. The office is in Lafayette, Ind.

RAILROAD EARNINGS IN JANUARY.

Name of Road.	Mileage. 1877.	1876.	In.	Dec	Per c.	Earnings. 1877.	1876.	Increase.	Decrease	P. c.	Earnings per mile. 1877.	1876.	Inc.	Dec.	P. c.
Atchison, Topeka & Santa Fe...	711	629	82	....	13.0	$126,651	$117,417	$9,234	.....	8.0	$178	$187	.....	$9	4.8
Burlington, Cedar Rapids & Northern.....	401	401	....	....	.....	73,964	91,934	.....	$17,970	19.6	184	229	.....	45	19 6
Cairo & St. Louis.....	146	146	....	....	.....	18,202	21,791	....	3,589	16.5	125	149	.....	24	16.5
Canada Southern.....	452	452	....	....	.....	107,893	123,741	.....	15,848	12.8	239	274	.....	35	12.8
Central Pacific.....	1,634	1,315	319	....	24.3	1,125,000	994,339	130,661	.....	13.1	688	756	.....	68	9.0
Chicago & Alton.....	650	650	....	....	.....	338,037	305,597	32,440	.....	10.6	520	470	$50	.....	10.6
Chicago, Milwaukee & St. Paul..	1,402	1,400	2	..	0.1	375,460	527,546	.....	152,086	28.8	268	377	.....	109	28 9
Chicago, Rock Island & Pacific..	723	699	24	....	3.4	500,638	489,638	11,000	.....	2.2	692	700	.....	8	1.1
Cincinnati, Lafayette & Chicago	75	75	....	....	.....	23,813	34,423	.....	10,610	30.8	318	459	.....	141	30.8
Cleveland, Mt. Vernon & Delaw.	157	157	....	....	.....	26,379	29,049	.....	2,670	9.2	168	185	.....	17	9.2
Denver & Rio Grande.....	269	120	149	....	124.2	43,270	33,679	9,591	.....	28.5	161	281	.....	120	42.8
Illinois Central, Main Line.....	707	707	....	....	.....	374,838	426,163	.....	51,325	12.0	530	603	.....	73	12.0
Illinois Cent., Iowa leased lines.	402	402	....	....	.....	91,661	127,411	.....	35,750	28.1	228	317	.....	89	28.1
Indianapolis, Bloom. & West'n..	344	344	....	....	.....	92,168	133,386	.....	41,218	30.9	268	388	.....	120	30.9
International & Gt. Northern...	516	459	57	....	12.4	179,196	140,346	38,850	.....	27.7	347	306	41	.....	13.4
Missouri, Kansas & Texas.....	786	786	....	....	.....	237,032	256,459	.....	19,427	7.6	302	326	.....	24	7.6
Nashville, Chattanooga & St. L.	341	341	....	....	.....	150,466	173,385	.....	22,919	13.2	441	508	.....	67	13.2
Ohio & Mississippi.....	623	623	....	....	.....	395,350	315,795	79,555	.....	25.2	635	507	128	.....	25.2
Paducah & Memphis.....	115	115	....	....	.....	15,110	21,502	.....	6,392	29.7	131	187	.....	56	29.7
Philadelphia & Erie.....	288	288	....	....	.....	232,550	231,193	1,357	.....	0.6	808	803	5	.....	0.6
St. Louis, Alton & Terre Haute, Belleville Line.....	71	71	....	....	.....	51,413	38,980	12,433	.....	31.9	724	549	175	.....	31.9
St. Louis, Iron Mt. & Southern..	685	685	....	....	.....	397,500	327,190	70,310	.....	21.5	580	478	102	.....	21.5
St. Louis, Kansas City & North'n	504	504	....	....	.....	240,042	246,099	.....	6,057	2.5	476	488	.....	12	2.5
St. Louis & Southeastern	349	349	....	....	.....	90,122	80,842	9,280	.....	11.5	258	232	26	.....	11.5
Toledo, Peoria & Warsaw.....	237	237	....	....	.....	78,571	99,208	.....	20,637	20.8	332	419	.....	87	20.8
Totals.....	12,588	11,955	633	....	.....	$5,385,326	$5,387,113	$404,711	$406,498	.....	$428	$451	.....	$23	5.1
Total increase or decrease.	.....	.....	633	...	5.3	.....	.....	.....	1,787	0.03	.....	.....	.....	.....	.....

TRAFFIC AND EARNINGS.

Railroad Earnings.

Earnings for various periods are reported as follows:

Year ending Nov. 30:	1875–6.	1874–5.	Inc. or Dec.	P. c.
Mobile & Montgomery.....	$689,627	$614,616	Inc ..	$75,011	12.2
Expenses.....	439,820	435,069	Inc ..	4,751	1.1
Net earnings.....	$249,807	$179,547	Inc ..	$70,260	39.1
Earnings per mile.	3,853	3,434	Inc ..	419	12.2
Per cent. of exps..	63.78	70.79	Dec..	7.01	9.9
Year ending Dec. 31:	1876.	1875.			
Chicago, Burlington & Quincy.....	$12,057,794	$11,791,361	Inc ..	$266,433	2.0
Expenses.....	6,868,545	6,430,123	Inc ..	438,422	6.8
Net earnings.....	$5,189,249	$5,361,238	Dec..	$178,011	3.2
Earnings per mile.	9,051	9,300	Dec..	249	2.7
Per cent. of exps..	56.97	54.53	Inc ..	2.44	4.5
Chicago & Alton.....	4,960,528	4,656,764	Inc ..	303,764	6.5
Expenses.....	2,804,390	2,604,125	Inc ..	200,165	7.7
Net earnings	$2,156,238	$2,052,639	Inc ..	$103,599	5.0
Earnings per mile.	7,632	7,164	Inc ..	468	6.5
Per cent. of exps..	56.54	55.92	Inc ..	0.62	1.1
Davenport & Northwestern.....	170,914	173,556	Dec..	2,640	1.5
Expenses.....	187,743	.....	.....	.....	....
Deficit	$16,829	.....	.....	.....	....
Earnings per mile.	1,089	.....	.....	.....	....
Per cent. of exps..	109.86	.....	.....	.....	....
Hannibal & St. Joseph.....	1,927,933	1,661,473	Inc ..	266,460	16.0
Marietta & Cincinnati	1,637,052	1,662,015	Dec..	24,963	1.5
Expenses.....	1,291,871	1,290,591	Inc ..	1,280	0.1
Net earnings.....	$345,181	$371,424	Dec..	$26,243	7.1
Earnings per mile.	5,214	5,293	Dec..	77	1.5
Per cent. of exps..	78.91	77.65	Inc ..	1.26	1.6
Mobile & Ohio.....	2,093,598	1,914 342	Inc ..	179,256	9.4
Northern Central....	4,369,926	4,926,248	Dec..	556,322	11.3
Expenses.....	3,036,486	3,362,124	Dec..	325,638	9.7
Net earnings.....	$1,333,440	$1,564,124	Dec..	$230,684	14.8
Earnings per mile.	13,405	15,111	Dec..	1,706	11.3
Per cent. of exps..	69.48	68.25	Inc ..	1.23	1.8
Month of December:					
Hannibal & St. Joseph.....	$158,812	$151,709	Inc ..	$7,103	4.7
Mobile & Ohio.....	300,000	291,014	Inc ..	8,986	3.1
Wellington, Grey & Bruce	23,815	29,653	Dec..	5,838	19.7
Month of January:	1877.	1876.			
Philadelphia & Erie.	$232,550	$231,193	Inc ..	$1,357	0.6
Expenses.....	156,221	150,842	Inc ..	5,379	3.6
Net earnings.....	$76,329	$80,351	Dec..	$4,022	5.0
Per cent. of exps..	67.16	65.24	Inc ..	1.92	2.9
Second week in February:					
Denver & Rio Grande	$10,302	.....	.....	.....	....
St. Louis, Iron Mt. & Southern.....	111,100	$98,913	Inc ..	$12,187	12.3
Third week in February:					
Chicago, Milwaukee & St. Paul	$99,000	$122,721	Dec..	$23,721	19.3

Coal Movement.

Coal tonnages for the week ending Feb. 17, are reported as follows:

	1877.	1876.	Inc. or Dec.	P. c.
Anthracite.....	278,322	57,687	Inc ..	220,635	382.4
Semi-bituminous.....	50,177	33,900	Inc ..	16,277	48.0
Bituminous, Barclay.....	6,533	3,525	Inc ..	3,008	85.3

In the corresponding week of 1876 there was a general suspension of production by the anthracite companies.

The Cumberland mining companies have resolved to adhere strictly to their decision to pay only 50 cents per ton for mining coal. The miners have held a delegate meeting and resolved, after long discussion, to take nothing less than 55 cents. There is a prospect of a long suspension.

Coal shipments over the Pennsylvania Railroad in January were:

	1877.	1876.	Inc. or Dec.	P. c.
Anthracite.....	57,873	32,860	Inc ..	25,013	76 0
Semi-bituminous.....	128,593	92,245	Inc ..	36,348	39.4
Bituminous.....	164,329	129,496	Inc ..	34,833	26.8
Total coal.....	350,795	254,601	Inc ..	96,194	37.8
Coke.....	86,259	62,782	Inc ..	23,477	37.4

The tons are of 2,000 lbs.

PERSONAL.

—Mr. Henry J. Southmayd, who was for 30 years Treasurer of the New Jersey Railroad & Transportation Company, died Feb. 23 at his residence in Jersey City. He was 65 years old and was the last survivor of the older generation of the officers of that company.

—President John W. Garrett has declined to serve as a director of the Atlantic & Pacific Telegraph Company, to which position he was elected last week.

—Mr. James Hargan has resigned his position as President of the St. Louis, Bloomfield & Louisville Railroad Company.

THE SCRAP HEAP.

Capture of Train Robbers.

A Terre Haute (Ind.) dispatch of Feb. 23 says: "Light was thrown to-day upon the attempted train robbery and murder of Milo Eames, engineer, at Long Point, on the Vandalia Railroad, in July, 1875. The supposed murderers, Charles St. Clair, a hackman; Bud Shoemaker, a brakeman on the train at the time of the attack; Sam and Alexander Canthom, colored; Billy Carr and Jennie Osgood, all of this city, were arrested to-day on evidence which seems to be sufficient to convict them of the crime.

"St. Clair, the leader, is the owner of a disorderly house here. The first clew to his guilt was obtained by women in his own house, who heard St. Clair talking to one of his associates about their failure in the Long Point business. The prisoners were taken to Prairie City, Ill., to-day for trial.

"The woman, Jennie Osgood, was dressed in men's clothes at the time of the attack on the train, and wore a false mustache. She was on the engine when Eames was killed. She has signified her intention to tell all she knows."

OLD AND NEW ROADS.

Louisville & Nashville.

The new depot in Montgomery, Ala., for the South & North Alabama road was formally opened Feb. 15. It is very large and convenient and is used by all the roads entering the city under arrangement with this company.

It is proposed to build a branch from Elmore, Ala., on the South & North road, east to Wetumpka, about eight miles.

Zanesville & Marietta.

It is proposed to build a narrow-gauge road from Zanesville, O., southeast to Marietta, about 50 miles through a somewhat difficult country.

Erie.

The Court has given Receiver Jewett permission to sue, through counsel in London, for the recovery of a large amount of money claimed to be due from Bischoffsheim & Goldschmidt, of London, formerly bankers and agents for the company.

Extensions of Mail Service.

Mail service has been ordered over the Chicago & Northeastern road, the new extension of the Chicago & Lake Huron road, from Flint, Mich., to Lansing, 46 miles.

Henderson & Overton.

The grading of this road is now all completed from Henderson, Tex., northwest 16 miles to the International & Grand Northern at Overton. Track has been laid for five miles from Overton and the work is progressing steadily. The company has just received an engine and several cars.

Southern Minnesota.

This road was sold, pursuant to notice, Feb. 10, under foreclosure of the equipment or second mortgage, and was bought by Albon P. Man and H. P. Cammann, trustees, under that mortgage. The trustees have called a meeting of the bondholders interested in the purchase, at St. Paul, March 3, to organize a new company in accordance with the law providing for such cases.

Chicago, Danville & Vincennes.

After hearing argument the United States Circuit Court has decided to confirm the sale of the Illinois Division of this road.

Chicago, Dubuque & Minnesota.

In Davenport, Ia., last week, the United States Circuit Court decided to dissolve the temporary injunction lately granted, and to allow the decree of strict foreclosure, heretofore granted, to be carried out. The agent for the trustees, Mr. F. O. Wyatt, in consequence of this decision, took formal possession of this road and the Chicago, Clinton & Dubuque, on March 1.

It is understood that the stockholders have withdrawn all opposition to the completion of the foreclosure, and that they are to receive $100,000 in bonds of the organized company for their interest.

Central, of New Jersey.

The locomotive enginemen object to the weekly payment of wages proposed by the Receiver on the ground that the agreement made with the company after the recent strike provided for monthly payments, and they fear that if one clause of the agreement is altered others may be. They will therefore decline to receive pay otherwise than monthly, as provided.

A general law is now pending in the New Jersey Legislature and will probably pass. It is intended to cover the case of this road and other similar cases, and to authorize the payment of arrears of wages from the earnings of the road under the Receiver.

Atlanta & Richmond Air Line.

At the adjourned meeting of bondholders in New York, Feb. 27, the committee recommended that a new first-mortgage for $500,000 be issued to supply means to put the road in good order and buy necessary equipment. The recommendation was adopted, with the provision that the new bonds shall first be offered to the purchasing bondholders, who now own the road.

Waco, Fairfield & Palestine.

The preliminary surveys have been completed and a very good line found. The distance from Waco, Tex., eastward to the proposed junction with the International & Great Northern near Butler is 90¼ miles; the engineer's estimate of cost is $542,600, without equipment.

Western North Carolina.

The North Carolina Legislature has finally passed the bill providing for the completion of this road, and retained the provision giving one-fourth of the stock and three directors to the stockholders of the old company.

Atlantic & North Carolina.

This company failed to pay the half-year's interest due Jan. 1 on the $200,000 first-mortgage bonds which constitute the only funded debt. The State of North Carolina holds two-thirds of the stock and names a majority of the board, and in January Gov. Vance named an entire new set of State directors. The old incumbents, however, declined to surrender their positions, claiming that they were entitled to hold until the annual meeting in June. They have also declined to pay the interest, although there is money in the treasury, pleading that a suit has been begun to set aside the mortgage on the ground of its illegal execution. Gov. Vance communicates these facts to the Legislature, and charges that the suit referred to was begun at the instigation of the old directors, and that their present object is to stave off the payment of interest for three months from the default, when, by the terms of the mortgage, the bondholders can take possession and sell the road. He asks the Legislature to appoint a committee to investigate the affairs of the company and to pass a bill authorizing the levying of an assessment on the stock to pay the overdue interest and the other floating debt, which amounts to about $30,000.

Chicago, Milwaukee & St. Paul.

The bill to take away the right of bondholders to vote has been indefinitely postponed by the Wisconsin Senate. It is now thought that it will not pass. It is said to have originated with the Sage party in New York, who hoped through it to secure control at the next election and to oust the present management.

The old Bright suit to set aside the foreclosure and sale by which the present company acquired possession of the old La Crosse & Milwaukee road, is now awaiting decision in the United States Circuit Court in New York. It has been before the courts in various forms for nine or ten years past.

Chesapeake & Ohio.

The Governor of Virginia has addressed a message to the Legislature calling attention to the interest of the State in this road in view of the approaching foreclosure. He claims that the company has not complied with the contract under which the State transferred to it the Covington & Ohio road. He intimates that there has been mismanagement and extravagance, and suggests a Legislative inquiry into the facts. He reports also that he has appointed counsel to represent the State in the foreclosure suit.

A number of suits have been begun in Louisville to recover on notes given by the company to the Ohio Falls Car Company in 1873, and now held by various parties. They amount in all to about $250,000, and are secured by the pledge of bonds of the company to the nominal amount of $350,000.

Boston & Maine.

There is little new with regard to the strike on this road. Trains are now running regularly and without trouble, but the striking enginemen are still hopeful of ultimate success.

President White writes as follows to the Boston *Advertiser*:

"My attention has been called to the fact that certain evil-disposed persons persist in circulating reports, which find their way into the newspapers, to the effect that many of our locomotives have been damaged by burning, or otherwise injured; that incompetent men and men of intemperate habits have been employed and are now running our engines; that grade crossings of other railroads have been passed without the stop required by law, and that hair-breadth escapes from terrible collisions have occurred since the engineers' strike on the 12th instant. * * * * * *

"In this state of things it becomes my official duty to inform the public that up to the present time not one of these insinuations and statements of damages and hair-breadth escapes from serious collisions, saving and excepting two engines slightly burned, has the least foundation in truth. The engineers recently employed and now running our trains are all believed to be good and safe men. Many of them come to us with the highest recommendations for skill and sobriety. * *

"It would not be strange if in the large number recently employed some should be found not up to the required standard. When this is discovered they will give place to others. We cannot expect and do not pretend that they are all perfect, but we believe them to be safe; they are certainly brave men, whom threats and intimidation cannot frighten. The road is now running all its passenger trains under the new schedule with very little delay, and we hope soon to be able to give the public the old accommodations. All our regular freight trains are moving daily, as well as a large number of extras, caused by the large accumulation of freight. The road is believed to be as safe for public travel as it has been at any time in the past."

Portland & Ogdensburg.

D. N. Stanton, of New York, has offered to buy the interest of the city of Portland in this road for $250,000, or less than one-tenth of its nominal value. It is not thought that the offer will be accepted, although the committee lately appointed by the City Council to investigate the affairs of the company and the city debt reported in favor of selling the city's interest in the road, even at a very great sacrifice. The committee was satisfied that no return could be expected from the road.

Ohio & Toledo.

Application was recently made for the appointment of a receiver for this road, but further proceedings were postponed to April 1, with the understanding that the company would by that time make an arrangement with its creditors, and in the meantime one-half the gross earnings are to be paid into Court.

Lake Erie & Louisville.

Pursuant to notice this road was sold under foreclosure of the first mortgage at Fremont, O., Feb. 24. It was bought for $250,000 by James B. Hodgskin, of New York, for account of the bondholders.

Illinois & St. Louis Bridge.

The damage done to the eastern railroad approach by fire was so far repaired that trains began to cross the bridge again Feb. 26. The carriage-way will not be in order for some time yet.

Peoria & Springfield.

Certain parties having petitioned the Court to remove Mr. J. R. Hilliard, Receiver of this road, the petition was referred to a master to take testimony. His report states that the charges of mismanagement made have not been substantiated, and that no reason has been shown for Mr. Hilliard's removal.

Ohio & Mississippi.

The hearing on the petition for a change in the Receivership was begun before the United States Circuit Court at Springfield, Ill., Feb. 28. Several counsel were to be heard on each side, and it was expected that the arguments would take several days.

St. Louis, Keokuk & Northwestern.

It has been decided to complete the St. Louis connection, and work is to be begun next week on the extension from Clarksville, Mo., south by east to the St. Louis, Kansas City & Northern at Dardennes. The distance is about 45 miles and the iron has been purchased.

Atlantic, Mississippi & Ohio.

In accordance with the understanding heretofore arrived at, six orders have been entered in the United States Circuit Court by consent of all parties in the suit. They are, in brief, as follows: 1. Giving permission to the Receivers to allow the master of accounts a sum not exceeding $125 per month for his services. 2. Allowing the Receivers each $10,000 per annum for their services. 3. Allowing Legh R. Page $3,000 for services as counsel for the Receivers, less any amount heretofore paid. 4. Authorizing the Receivers to sell any waste or useless material they may think proper. 5. Granting Receivers authority to pay employes who have not assigned their claims, beginning with the pay-roll of July, 1875. 6. Authorizing the Receivers to pay coupons of divisional mortgages due Jan. 1, 1877.

The Richmond *Dispatch* has discovered a plot to buy and divide the road, the Baltimore & Ohio to take the line from Lynchburg west and the Chesapeake & Ohio the rest, a connection with the last-named road to be made by building from Clifton Forge to Bonsack's. The *Dispatch* is not informed of the details of the plot, but is positive as to its existence.

Peoria & Rock Island.

Several bondholders have petitioned to have the decree of sale amended, on the ground that it is not just to give the contract with the Coal Valley Mining Company a priority over the mortgage lien. Neither trustees nor bondholders were parties to that contract, and no mention of it is made in the mortgage, and at the time it was made only the 12 miles of road from Coal Valley to Rock Island were built. Petitioners ask that the road be divided and the sections from Coal Valley to Rock Island and from Coal Valley to Peoria be sold separately, or, if the road is sold in one parcel, that the operations of the contract be expressly confined to the section from Coal Valley to Rock Island.

Springfield, Athol & Northeastern.

Attachments to the amount of nearly $200,000 have been put on the property of this company, and it is said that the bondholders are making arrangements to foreclose. The largest floating-debt creditor is Mr. Willis Phelps, who has claims for money advanced amounting to about $117,000, and who has also advanced a considerable amount to pay interest on the bonds, holding the coupons as security. By the last annual report (Sept. 30, 1876) the total funded and floating debt, less cash on hand, was $736,589; the net earnings for the year were $29,466, or much less than the interest. The road is 48½ miles long, from Springfield, Mass., to Athol, and was opened from Athol to Barrett Junction in 1871 and to Springfield in 1873, the latter city having taken a large amount of stock in the extension. The road has always had a very light business and much of the time has hardly earned its working expenses, leaving nothing for equipment and improvements.

New Orleans, Jackson & Great Northern.

An adjourned meeting of holders of consolidated bonds was held in New York, Feb. 26. A committee was appointed to prepare a plan for the reorganization of the company, which will be submitted to a meeting to be called by the committee.

Georgia Railroad Bonds.

The late Legislature of Georgia passed a bill authorizing the issue of bonds of the State amounting to $2,298,397 for the purpose of retiring by exchange or paying off the recognized bonds of the Macon & Brunswick Railroad to the amount of $1,950,000, the bonds of the North & South Railroad to the amount of $240,000, and the bonds of the Memphis Branch Railroad to the amount of $34,000, and also to fund the interest on these bonds to Jan. 1, 1877, to the amount of $74,397. The object of this bill is to fund all the endorsed railroad bonds in 6-per-cent. straight bonds of the State. New bonds shall be sold for not less than par, and the proceeds shall be applied to redeem at par all endorsed railroad bonds.

George's Creek & Cumberland.

The claims of this projected road were presented to the committee of bondholders and stockholders of the Chesapeake & Ohio Canal in Baltimore, Feb. 27, the object being to secure aid for the road from the Canal Company. The project is advocated by nearly all the outside coal companies, and they urge that the Consolidation Coal Company and its road are now so controlled by the Baltimore & Ohio interest that the canal can hope to secure very little of the Cumberland business hereafter unless it has a connection of its own with the mines.

Mobile & Ohio.

The hearing on the trusteeship question has been put over to the April term of the United States Circuit Court at Mobile.

Maryland & Delaware.

This road does not appear to be in first-class condition, for a Delaware paper says that last week the directors held a meeting at Easton, Md., for the purpose of considering the advisability of stopping the cars, owing to the unsafe condition of several of the bridges on the road. The board concluded to continue the running of the trains for the present; and, to be sure that the bridges are safe, an experienced bridge builder is to be employed immediately to test the condition of the trestle-work.

Chicago, Rock Island & Pacific.

This company has announced its intention of calling in the 7 per cent. sinking fund bonds which mature in 1896, in accordance with the right reserved when the bonds were issued. The company intends to execute a new mortgage on the property for $12,500,000, under which it will issue $9,000,000 6 per cent. 40-year bonds to replace the present 7 per cent. bonds; $1,000,000 of the same bonds to replace the present 6 per cent. bonds, and will retain $2,500,000 as a reserve to use for new extensions or improvements when necessary. The new mortgage will be made to the United States Trust Company, of New York, as trustee, and will cover all the property of the company, on which it will be the only mortgage lien when the bonds now outstanding are retired. The change from 7 to 6 per cent. bonds can probably be made without difficulty, and will save the company some $90,000 a year in interest.

Union Pacific.

It is reported that this company intends to build a branch to the Black Hills. Three routes are to be surveyed, from North Platte, Sidney and Cheyenne.

Dutchess & Columbia.

The New York Central & Hudson River Company has caused the removal of the rail connections at Dutchess Junction, N. Y., so as to prevent the coal trains of this company from running across its track to the Hudson River. Negotiations are in progress for an arrangement which may be satisfactory to both parties.

Broadway Underground.

In the New York Senate last Tuesday Senator Gerard introduced a bill extending the time for the Broadway Underground Railway (the old Beach Pneumatic) to build its first section (from Bowling Green to Harlem River) five years after May 1, 1877, on the filing of a certificate by the Engineer Commissioners that the whole capital stock of the company has been subscribed or such financial arrangements made as will insure the construction of the road within the time limited.

Hoosac Tunnel Line.

In the Massachusetts Legislature last week a petition was received from Estes Howe, Oliver Ames, Elisha Atkins, William Claflin, William L. Burt, John W. Candler, John B. Alley and others, directors of the Boston, Hoosac Tunnel & Western Railway of New York—already organized under the laws of New York, asking for authority to enter upon and use the Hoosac Tunnel and Troy & Greenfield Railroad upon a fixed rate of toll, graduated upon a sliding scale proportioned to the annual use; to construct or purchase and operate any road between Greenfield and the city of Boston that may be necessary for a through line from tide-water in that city to Lake Ontario, and for legislation to secure the co-operation of the Fitchburg and the Vermont & Massachusetts railroads. The petitioners set forth that they require no pecuniary aid or assistance in this enterprise of an independent through line, a majority of the directors of which shall be residents of Massachusetts. Its principal place of business is to be maintained in Boston, and the Lieutenant-Governor and the President of the Boston Board of Trade are to be *ex-officio* directors.

A petition, accompanied by the draft of a bill, was also received from John W. Ayers of South Boston, providing for the

improvement of the railroad connections from the South Boston flats by way of the Hoosac Tunnel to the great railroad systems of the West, and allowing the City of Boston to aid in building the necessary connecting links.

South Pacific Coast.

The track is now laid to San Jose, Cal., five miles south of the late terminus at Santa Clara and 20 miles from Dumbarton Point. The ferry steamer to ply between San Francisco and Dumbarton Point is nearly finished and trains will be put on the road to San Jose as soon as the steamer is ready. Two gangs of men are also at work on the grading between San Jose and Los Gatos.

Central Pacific.

This company and the Southern Pacific are now planting large quantities of the Eucalyptus or blue-gum tree along their lines. The tree grows rapidly and is very good for ties, and the companies expect in a few years to derive their supply from their own plantations. A few catalpa trees are also being planted as an experiment, for the same purpose. The latter is said to last long, but to be too soft to hold spikes well.

Chicago & Pacific.

At a special meeting in Chicago, Feb. 21, the stockholders' committee appointed at the annual meeting recommended that the stockholders disapprove of the former action of the directors in executing a trust deed and issuing bonds, and that the officers of the company be instructed to defend the foreclosure suit now pending. The committee was continued, to report at a future meeting.

Boston & Lowell.

This company has asked the Massachusetts Railroad Commission for leave to cross the Boston & Maine track at South Lawrence and to bridge the Merrimac River. The object is to extend the Lawrence Branch from South Lawrence to North Lawrence and build a depot there.

Naugatuck.

The Waterbury (Conn.) *American* says that the 816 shares of stock held by the company were recently sold at 130, all of it being taken up by old stockholders. The full amount of capital stock authorized ($2,000,000) has now been issued; the company has no funded debt and no floating debt of any amount.

Massachusetts Central.

This company has applied to the Massachusetts Legislature for an extension of two years in the time for completion of the road. President Stone stated at the committee hearing on the bill that he was confident of the company's ability to finish the road in two years, although he failed to state the grounds of his confidence. The road is to extend from a junction with the Boston & Lowell near Boston to Northampton, about 95 miles. Some $2,500,000 is said to have been expended on it, and about two-thirds of the grading and masonry is done, including some of the work on the Connecticut River bridge at Northampton. But nearly all of the capital stock has been paid in, and that remaining to be collected is principally town subscriptions the payment of which is resisted and which will require an expensive litigation with uncertain results. The sole reliance of the company is on its bonds, the negotiation of which just now would be a difficult matter.

Atlantic & Gulf.

An adjourned meeting of the local holders of bonds was held in Savannah Feb 17. The committee previously appointed reported that the liabilities of the company were as follows:

Bills payable and transient accounts	$282,760 92
Due bills	89,000 00
Interest overdue and unpaid	86,500 00
Total	$458,260 92

There is also a claim of the State of Georgia for taxes, $50,845.01, and one of P. J. Avery for $328,327.26, both in litigation; $500,000 coupon notes and $25,000 interest on the same will be due April 1. The cash on hand and due the company amounts to $68,620.18. The committee recommended that the road be sold as soon as possible.

President Screven made a statement, not denying the present embarrassments of the company, but holding that the property was worth much more than the debts upon it. He proposed that the coupons be funded until January, 1878. After some discussion it was resolved to appoint a committee of five to confer with the New York bondholders and to secure the appointment of a trustee to the vacancy under the consolidated mortgage, to act with the surviving trustee, Mr. Jesup, of New York.

In the United States Circuit Court at Savannah proceedings in foreclosure have been begun and the appointment of a receiver asked for.

St. Louis, Lawrence & Western.

This road was sold under foreclosure of mortgage in Lawrence, Kan., Feb. 23, and was bought for $200,000 by Frank Morrison, of Boston, for account of the bondholders. It is reported that the Atchison, Topeka & Santa Fe Company is desirous of securing control. The road extends from Pleasant Hill, Mo., through Lawrence to Carbondale, Kan., 93 miles.

York & Western.

It is proposed to build a narrow-gauge road from York, Pa., west by north through Weigelsville and Dover to Rossville, about 13 miles. It is claimed that such a road would command a considerable traffic as the only outlet of a rich farming country.

Sandersville & Tennille.

Local papers state that this short road is doing an excellent business, and that its builders are well satisfied with its operations. It was built to connect the town of Sandersville, Ga., with the Central Railroad of Georgia at Tennille, about five miles distant. It is a light road, laid with rails 30 pounds to the yard, and is equipped with a light engine of Porter, Bell & Co.'s build and a suitable passenger car. No separate freight equipment is needed, as the road has been built of the same gauge as the Central (5 ft.), and the cars of that road run to Sandersville.

Atlantic & North Carolina.

The County Commissioners of Craven County, N. C., and a private stockholder have applied for an injunction to restrain this company from paying interest on its $200,000 first-mortgage bonds on the grounds that their issue was not warranted by the charter and that the interest is usurious.

East Tennessee, Virginia & Georgia.

The North Carolina Legislature has authorized this company to extend the Morristown Branch from Wolf Creek, Tenn., to Warm Springs in Madison County, N. C., and to use in such extension the surveys and right of way of the French Broad Valley Branch of the Western North Carolina.

Norwich & Worcester.

At a special meeting held in Norwich, Conn., Feb. 17, the stockholders voted to authorize an issue of new bonds to the amount needed to pay for the cost of improvements in Worcester, and for other extraordinary expenses, and to provide for the payment of certain bonds which become due in July next.

Minneapolis & St. Louis.

This company has concluded a lease for 999 years of the Minneapolis & Duluth Railroad, which it has for some time operated under temporary agreement. The annual rental is to be $19,600, gold, payable in two semi-annual installments, the lessee to pay the taxes and $100 per year to keep up the organization. The Minneapolis & Duluth road extends from Minneapolis, Minn., northeast to a junction with the Lake Superior & Mississippi, and is 15 miles long.

Chesapeake & Ohio.

Governor Kemper, of Virginia, has sent a special message to the Virginia Legislature, urging the necessity of taking some action to protect the State's interest in this road, in view of the near approach of the foreclosure sale.

ANNUAL REPORTS.

Northern Central.

This company owns a line from Baltimore northward to Sunbury, Pa., 138 miles, with an extension of 4 miles in Baltimore and a branch from Relay, Md., to Green Spring, 9 miles; in all 151 miles. It works under lease the Shamokin Valley & Pottsville road, from Sunbury to Mt. Carmel, 28 miles; the Elmira & Williamsport road, 78 miles; the Chemung road, 22 miles, and the Elmira, Jefferson & Canandaigua road, 47 miles. the three last forming a continuous line 147 miles long from Williamsport to Canandaigua. The total mileage is 151 owned and 175 leased, 326 in all. Its trains also run over 40 miles of the Philadelphia & Erie, from Sunbury to Williamsport, completing a line of 325 miles from Baltimore to the New York Central at Canandaigua. The Philadelphia & Erie trains also use 47 miles of the Northern Central, from Sunbury to Marysville. The report is for the year ending Dec. 31, 1876.

The capital account at the close of the year was as follows:

Stock ($38,691 per mile)		$5,842,000 00
Maryland State loan, irredeemable	$1,500,000	
First and general mortgage bonds	8,845,000	
Second-mortgage bonds	4,000,000	
Bonded debt ($95,000 per mile)		14,345,000 00
Bills payable	$1,345,322 56	
Interest and rentals accrued	397,954 58	
December pay-rolls and vouchers	243,262 70	
Other liabilities	112,673 38	
		2,099,213 22
Profit and loss		176,546 77
Total ($148,760 per mile)		$22,462,759 99

The annual interest charge is $830,700, or $5,501 per mile owned. The company owns securities of its leased lines costing $3,048,680.82 and real estate valued at $180,000 not used for the road. During the year the second-mortgage bonds authorized last year were issued; $1,000,000 at 6 per cent. were exchanged for a like amount of the old 7 per cent. convertible income bonds, $2,756,000 at 5 per cent. interest were exchanged for a like amount of the old income bonds and $244,000 are held to exchange for the remaining income bonds. Bills payable were increased by $878,901.61 during the year, of which $421,889.19 was for improvements at Canton; $83,480.73 for real estate in Baltimore; $200,000 on account of purchase of 1,000 new coal cars, and $100,000 for purchase of Tioga Railroad bonds by agreement. The company has in reserve $1,000,000 first and $1,000,000 second consolidated bonds.

The passenger and freight traffic of the year was:

	1876.	1875.	Inc. or Dec.	P. c.
Passengers carried	1,903,645	1,568,186	Inc.. 335,459	21.4
Passenger mileage	43,401,086	29,829,323	Inc..13,571,763	45.5
Tons freight carried	5,579,024	5,793,635	Dec.. 214,611	3.5
Tonnage mileage	253,552,485	258,540,557	Dec.. 4,988,072	1.9
Receipt per passenger per mile	2.146 cts.	.....	.....	...
Cost per passenger per mile	2.105 "	.....	.....	...
Net per passenger per mile	0.041 "	.....	.....	...
Receipt per ton per mile	1.274 "	1.433 cts.	Dec.. 0.159 cts.	11.1
Cost per ton per mile	0.918 "	.....	.....	...
Net " "	0.356 "	.....	.....	...

The increase in passenger traffic was principally in through and local travel to the Centennial, and as these passengers were carried at very low rates there was but a comparatively small increase in earnings. The report says: "The coal tonnage of the Northern Central Railway in 1875 was 1,077,121 tons, and in 1876, 832,172 tons. There was a decrease in the trade going on to the Pennsylvania Railroad at Marysville and Dauphin of 215,826 tons. There was a decrease of 6,790 tons to points on the Cumberland Valley Railroad. The total tonnage to Baltimore was 261,385 tons, a decrease of 6,550 tons in 1876. The coal tonnage of the Shamokin Branch in 1876 was 587,274 tons, in 1875, 788,034 tons—showing a decrease of 200,760 tons. The coal tonnage of the Elmira & Williamsport Railroad in 1876 was 377,522 tons, and in 1875, 338,938 tons, an increase of 38,584 tons. The increase from the McIntyre mines, near Ralston, was 37,397 tons. In the north-bound anthracite trade there was a decrease of 28,059 tons. The coal tonnage of the Chemung railroad was increased from 645,125 tons in 1875, to 740,756 in 1876—a total increase of 95,631 tons. The increase from the Blossburg region was 79,359 tons, and the coal trade from this company's lines, and from the Lehigh Valley Railroad, was increased 16,272 tons. On the Canandaigua Railroad the coal tonnage of 1875 was 516,809 tons, in 1876, 552,651 tons—an increase of 35,842 tons. There was a decrease of 92,708 tons in shipments to Coal Point at Watkins, N. Y., and an increase of 128,550 tons in shipments to other stations. On the Green Spring Branch the coal tonnage of 1875 was 12,014 tons; in 1876, 8,886 tons—a decrease of 3,128 tons. From the foregoing statistics of the traffic of your lines it will be seen that the reduction in tonnage and revenue therefrom was mainly on coal, but there was also a falling off in all articles used in the manufacture of iron and in the lumber trade. The entire loss of tonnage and revenue was, in fact, in the local traffic, there having been an actual increase in all competitive traffic, both in tonnage and revenue. This fact shows that a moderate revival of the general business of the country will restore the traffic of your lines, with profitable results to the shareholders. The increase in competitive traffic is largely due to the additional facilities provided at Baltimore for handling it."

The earnings for the year were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Passengers	$931,782 92	$816,006 21	Inc..$115,776 71	14.2
Freight	3,230,288 32	3,691,762 48	Dec.. 461,474 16	12.5
Express and mail	114,436 11	133,206 22	Dec.. 18,770 11	14.1
Miscellaneous	93,418 15	285,272 81	Dec.. 191,854 66	67.3
Total	$4,369,925 50	$4,926,247 72	Dec..$556,322 22	11.3
Working expenses	3,036,485 81	3,362,123 68	Dec.. 325,637 87	9.7
Net earnings	$1,333,439 69	$1,564,124 04	Dec..$230,684 35	14.8
Gross earnings per mile	13,404 68	15,111 00	Dec.. 1,706 32	11.3
Net earnings per mile	4,090 31	4,798 00	Dec.. 707 69	14.8
Per cent of exp's.	69.48	68.25	Inc.. 1.23	1.8

The report says: "The earnings per mile of road were as follows: Northern Central Railway, Baltimore Division, 91 miles, $17,850.21; Northern Central Railway, Susquehanna Division, 47 miles, $24,437.98; Main Line, 138 miles, $20,093.87; Green Spring Branch, 9 miles, $996.45; Shamokin Division, 28 miles. $10,031.61; Elmira Division, 78 miles, $8,119.44; Chemung Division, 22 miles, $10,984.51; Canandaigua Division, 47 miles, $9,194.51. * * * * * *

"The above is a comparison of the earnings and expenses of the years 1875 and 1876, as taken from the books of the company. In order to arrive at a correct comparison, however, it must be stated that several changes in the accounts were made and put into effect on the 1st of January, 1876, which materially affect the above results. The changes referred to were made with a view to adopting what was thought to be a more correct system of keeping the accounts. They were as follows: Drawbacks and overcharges were heretofore charged to expenses. By the new system they are deducted from the earnings. Heretofore the entire amount of car service earned by this company's cars on foreign roads was credited to earnings, and the entire amount of car service paid out by this company for use on its lines of cars belonging to other companies, was charged to expenses. By the new system a balance is struck, which balance is either charged to expenses or credited to earnings, as the case may be. Again, rents paid for property used by the company, and interest on mortgages and ground rents, have heretofore been charged to operating expenses. These items are now included in the Treasurer's account, being debited to the annual income account. Interest on valuation of equipment owned by this company and used on leased lines has heretofore been charged as an expense of operating those lines. It is now charged against the income account of such leased lines. The reason for making these changes is obvious, the intention being to charge to operating expenses only the actual cost of working the line, and to credit to earnings the actual amount earned, after deducting all rebates and overcharges. These changes affect the above comparative results as follows: The gross earnings, instead of showing a decrease of $556,322.22 as compared with 1875, were only actually reduced $347,263.22, so that the decrease, instead of being 11 29-100 per cent., was 7 5-100 per cent. Again, the operating expenses, instead of showing a decrease of $325,637.87, would have shown a decrease of $79,862.70, if the accounts of the two years had been kept in the same manner. The Treasurer's account was increased on the debit side, by the changes referred to, $36,716.17. It will be understood, of course, that these changes do not affect the final net balance."

The income account for the year was as follows.

Balance, Jan. 1, 1876		$192,960 61
Net earnings		1,333,439 69
Dividends and interest		59,632 00
Pennsylvania R. R. Co., contribution for operating Elmira, Chemung and Canandaigua divisions		56,487 82
Total		$1,642,520 12
Interest	$831,870 00	
Interest, gold premium, etc	65,960 29	
Ground rents and land mortgages	36,716 17	
Shamokin Val. & Pottsville, rent and interest on equip	62,593 21	
Elm. & Williamsport, rent and interest on equip	198,977 26	
Chemung R. R., rent and interest on equip	13,777 28	
Elmira, Jeff. & Can., rent and interest on equip	50,239 33	
New sidings, buildings, etc	54 819 81	
Additional cost of 7,551 tons steel rails laid	151,020 00	
		1,465,973 35
Balance, Jan. 1, 1877		$176,546 77

The grain elevator and coal wharves at Canton have been completed, and are in use. The connection through the Elmira State Line road with the Tioga Railroad has also been completed, and a considerable coal traffic is expected from that line.

The report says: "While the above statement shows a balance of earnings equal to a dividend of 3 per cent. upon the capital stock, your board does not deem it wise to make a dividend, believing it to be more prudent to hold the existing balance in reserve. Although the expectations of your board have not been realized in the results of the past year, they are able to state to you that, notwithstanding the continued and increased depression in all departments of trade which prevailed during the entire year, especially in those branches upon which the traffic of your lines so largely depend—coal, iron and lumber—you enter upon the new year with your property greatly improved in its condition in all branches of the service, in its earning capacity, and in its capability of more economical movement of the traffic. * * *

"A marked improvement has been made in the condition of the track, special attention having been given by your officers to this important subject. Your motive power and car equipment were also greatly improved in condition and efficiency by the building of new locomotives and cars to replace an equal number worn out, and by the maintenance of the equipment in service in thorough repair. Your property in all its branches was, in fact, never in so good a condition as at present."

Poughkeepsie Bridge.

At the recent annual meeting in Poughkeepsie President Stone reported that the subscriptions to the stock amounted to $1,002,600, payable in 10 per cent. installments. The contract with the American Bridge Company was to build the bridge for $3,050,000 cash, or $3,412,000, payable $1,000,000 in cash and the balance in bonds. The first installment on the stock was called in Aug. 25, and of that $86,040 has been paid and $14,220 is still due. He recommended that calls be made hereafter at intervals of 30 days, in order that the company may make all payments under the contract promptly.

Chief Engineer P. P. Dickinson's report is as follows:

"Work on and under the contract of Jan. 21, 1876, made by this company with the American Bridge Company, for the construction of the Poughkeepsie bridge and its approaches, was commenced on Sept. 15 last.

"The former company having, by the terms of its contract, agreed to complete the bridge and its approaches ready for the passing of trains, for a specific amount, the first and important information for them to obtain was a confirmation of the general statements made by the officers of the Poughkeepsie Bridge Company, in reference to the probable character of the foundation for the proposed bridge.

"For this purpose, soundings and borings have been made by and under the direction of the American Bridge Company during the past season, at the site of each pier; the results showing that a good foundation can be had only by going to the hard gravel, overlying the bedrock, at a depth of about 100 feet for the west pier, and about 120 for the east pier. For the two centre piers good foundations are obtained on hard compact clay, at a depth of 80 feet. The depth of water was from 50 to 60 feet. The material through which it is necessary to sink the foundations is from 40 to 70 feet in depth, composed of silt, mud and sandy clay, free from large stones.

"The caisson for the east and west piers will be 100 feet long and 50 feet wide, allowing a pressure of 3.5 tons per square foot of base. The caisson for the two centre piers will be 60 feet wide and 100 feet long, allowing three tons pressure per square foot of base, with maximum load of pier and bridge.

"The caissons will be built of yellow pine and hemlock timber, framed and bolted together, and divided into 40 compartments by four longitudinal and seven transverse partitions, three feet in thickness. Twelve of these compartments, 12 feet square, are open at the bottom, and through these the material is to be excavated. The outer and centre compartments are closed at the bottom by timber built solid for a depth of 15 feet, and framed to form a wedge-shaped cutting edge at the base. The cross partitions only extend to a point four feet above the cutting edges. The closed compartments resting on the cutting edges, which are shod with iron, carry the weight required to sink the caisson to place.

"All compartments are to be filled with concrete, after the

caissons are sunk to place, up to a point 25 feet below the water line, where the cut or coursed masonry will commence. There will be required in each caisson about 1,200,000 feet of pine and hemlock, 120 tons of iron, wrought and cast, and 10,000 cubic yards of concrete.

"There is now under contract for delivery at Poughkeepsie 4,000,000 feet (board measure) of pine and hemlock, 1,000,000 of which is now delivered and 400,000 framed and in caisson.

"The first caisson, designed for the west pier, will be launched in a few days, and thereafter built up to a height of 20 feet, preparatory to towing to its final position. The base of the second and third will be framed during the winter. The first, designed for the foundation of the west pier, will be floated to position certainly by April 1, and will be ready to receive the masonry early in May. The second one will be put in position during the month of May, and the third and fourth immediately thereafter.

"I am informed by H. A. Rust, President of the American Bridge Company, that he is about closing contracts for the furnishing of materials necessary for the construction of the concrete foundations, as well also as for the stone for masonry. The latter will be either of Hudson River lime, New England or Hudson River granite.

"Flats, scows, derricks and other machinery required for the prompt and vigorous prosecution of the work, will be ready and on the ground at the opening of river navigation. It is expected that a force of at least 300 men will be employed during the approaching season on and about the work."

Eastern.

The new management of this company makes its report for the year ending Sept. 30, coinciding with the report to the Massachusetts Commission, thus changing the company year, which has heretofore ended with Nov. 30. The road worked is as follows:

	Miles.
Eastern Railroad, Boston to New Hampshire Line	41.390
East Boston Branch, double track	3.310
Charlestown Branch, double track	1.068
Saugus Branch	9.520
Swampscott Branch	3.800
Marblehead Branch	4.000
Lawrence Branch, 2 miles double track	19.660
South Reading Branch	8.120
Gloucester Branch	17.350
Essex Branch	5.000
Asbury Grove Branch	1.000
Salisbury Branch	3.750
Total owned	117.986
Eastern R. R., of New Hampshire, State Line to Portsmouth	15.90
Portland, Saco & Portsmouth R. R., Portsmouth to Portland, Me	51.00
Portsmouth & Dover R. R.	10.88
Newburyport City R. R.	2.80
Portsmouth, Great Falls & Conway R. R.	71.37
Wolfborough R. R.	12.03
Total leased	163.980
Total worked	281.966

The equipment consists of 94 engines and 27 snow-plows; 143 passenger and 37 baggage and mail cars; 756 box, 768 platform and 42 gravel and other cars. Of these 19 engines, 5 snow-plows, 1 passenger 2 baggage, 120 box, 131 platform and 8 other cars are leased; the rest are owned. There are 27.8 miles of second track on the Main Line, and 37.8 miles of sidings owned.

The general account is as follows:

Capital stock ($42,358 per mile)		$4,997,600 00
New mortgage certificates	$9,606,004 37	
Bonds	719,036 30	
Ten-year notes	1,742,500 00	
Accrued interest	176,383 00	
Essex R. R. bonds	194,400 00	
Total funded debt ($104,566 per mile)		12,337,323 67
Unfunded debt		256,608 84
Bills payable		2,420,159 92
Interest and dividends unpaid		43,539 93
Current balances		197,591 24
Total ($171,654 per mile)		$20,252,823 60

The company is liable by lease or guarantee for interest on $514,000 Portsmouth, Great Falls & Conway bonds; $63,000 notes and $700,000 stock of the Portsmouth & Dover; $250,000 notes and $1,500,000 stock of the Portland, Saco & Portsmouth; $48,600 Wolfborough, and $100,000 Newburyport City stock. It owns, besides the road and equipment, real estate valued at $999,382; 15,274 shares Maine Central stock, valued at $610,960; 390 shares Pullman Car stock, valued at $28,080; 5,513 shares Portsmouth, Great Falls & Conway stock; 3,379 shares Wolfborough stock and 10 shares Eastern of New Hampshire stock, these three last-named securities being inventoried as of uncertain value.

The work done was as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passenger train mileage	1,085,229	1,065,092	Inc.. 20,137	1.9
Freight train mileage	578,658	575,390	Inc.. 3,268	0.6
Service and switching mileage	369,621	442,250	Dec.. 72,629	16.4
Total	2,033,508	2,082,732	Dec.. 49,224	2.4
Passengers carried	4,796,275	5,386,038	Dec.. 589,763	10.9
Passenger mileage	69,453,812	75,201,867	Dec..5,748,055	7.6
Tons freight carried	634,508	661,886	Dec.. 27,378	4.1
Tonnage mileage	34,224,383	35,687,333	Dec..1,462,950	4.1
Average passenger train load, No.	64.00	70.61	Dec.. 6.61	9.4
Average freight train load, tons	59.14	62.02	Dec.. 2.88	4.6
Average receipt per pass. per mile, excluding season tickets	2.50 cts.	2.47 cts.	Inc..0.03 cts.	1.2
Average receipt per pass. per mile, all passengers	2.03 "	2.21 "	Dec..0.18 "	8.1
Average rate per ton, per mile	3.15 "			
Earnings per train mile	$1.186			
Expenses " "	0.878			
Net " "	0.308			

Of the passenger mileage 17.34 per cent., and of the tonnage mileage 37.33 per cent. was of business to and from other roads. There were 629,438 round trips made by season-ticket passengers, of which 432,614 were to and from Boston.

The earnings were as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passenger dep'tm't.	$1,498,408 66	$1,765,280 04	Dec. $266,871 98	15.1
Freight "	908,932 01	993,077 40	Dec. 84,145 39	8.4
Rents of road	4,800 00	8,000 00	Dec. 3,200 00	40.0
Miscellaneous	58,830 95	60,933 30	Dec. 2,102 35	3.5
Total	$2,470,971 02	$2,827,290 74	Dec. $356,319 72	12.6
Working expenses	1,787,376 96	2,069,871 61	Dec. 282,494 65	13.6
Net earnings	$683,594 06	$757,419 13	Dec. $73,825 07	9.7
Gross earn. per mile	8,755 18	10,025 85	Dec. 1,270 67	12.6
Net " "	2,424 09	2,685 81	Dec. 261 72	9.7
Per ct. of expenses	72 33	73 21	Dec. 0 88	1.2

The directors attribute the falling-off in traffic and earnings to the generally depressed state of business and manufacturing industry. The working expenses have been much reduced, the board enforcing the strictest economy consistent with the preservation of the property.

The income account may be summed up as follows:

Net earnings		$683,594 06
Rental Portland, Saco & Portsmouth R. R.	$107,500 00	
" Portsmouth & Dover R. R.	45,780 00	
" Wolfborough R. R.	2,916 00	
" Newburyport City R. R.	6,000 00	
" Portsmouth, Great Falls & Conway	35,980 00	
Total rentals	$198,176 09	
Interest on funded debt	736,724 40	
" " other "	202,453 84	
		1,137,354 24
Deficit for the year		$453,760 18
Add deficit, Sept. 30, 1875		272,590 02
" entries to profit and loss during the year		9,312,989 31
Total deficit, Sept. 30, 1876		$10,039,339 51

The enormous sum charged to profit and loss is to cover the general depreciation in assets according to the new inventory of the property.

The directors' report, after referring to the compromise made with the creditors and the passage by the Legislature of the act giving the necessary authority to carry it out, says:

"In administering the affairs of this corporation, the board propose faithfully to carry out the provisions of this act, in the hope and belief that the road may ultimately be extricated from its embarrassments, and that a foreclosure under the mortgage may be avoided. The work of exchanging the bonded and other unsecured indebtedness of the company into certificates of indebtedness has gone on in a very satisfactory manner.

"On the 1st of February, 1877, the total amount of certificates of indebtedness issued was $11,628,097.35.

"It will be seen by examining the figures of the financial statement how large a proportion of the total debt has been thus converted. There is every reason to believe that all of the unsecured debt will at an early day be converted under the general mortgage.

"A question has arisen in regard to some notes of the company, for which the amount of $585,000 of the ten-year coupon notes was pledged as security. The question is whether, under the act, these ten-year notes, pledged as collateral, are convertible into certificates of indebtedness, as well as the debt for which they are pledged, or whether the creditors holding them are not put to their election; and, if they would have their debts secured under the mortgage, are not bound to give up their collateral. Suit has been brought by one creditor, and the question has been argued in the Supreme Court. A decision in that case, when rendered, will virtually settle that matter as to all creditors in the like situation.

"A claim has been made and suit brought by the Eastern Railroad Company of New Hampshire to test the question of the validity of the lease of 1840, and of the supplementary agreement of 1862, under which this corporation has been in possession of and has operated the New Hampshire road ever since it was opened for travel. The suit has been transferred from the courts of New Hampshire to the United States courts, where the rights of both parties will unquestionably be fairly considered, and where this corporation will have an opportunity to be heard before any decision is made against it. There is no reason to expect any other result than one favorable to the interests of this corporation. * * *

"The property is at present generally in good condition, and has not been allowed to deteriorate during the year. In spite of the embarrassments of the company, the importance of keeping the track and rolling stock in an efficient condition has been fully recognized, and necessary repairs have been made; but no extension of track or additions to rolling stock have, under the circumstances, been thought wise. In repairs of track five miles have been relaid with new steel rails, and nine miles with rerolled iron rails, and 56,233 new ties have been used. For the coming year it is estimated that 20 miles of new steel rails will be needed for renewal of track now laid with iron. It has been found necessary to replace the wooden bridge over the Saco River near North Conway, on the Portsmouth, Great Falls & Conway Railroad, by a combination bridge of approved construction, which will be completed within a month.

"Insurance to the amount of $560,000—covering all the property of the company which is liable to damage by fire—has been effected on satisfactory terms.

"The Legislature of Massachusetts at its last session passed an act authorizing the railroad commissioners to prescribe a uniform system of keeping accounts to be adopted by the railroad companies of the State. A system has accordingly been prescribed by them, which has been adopted by this company, and was put into operation on the 1st of October. Certain defects in the method of accounts formerly in use had become evident, and would have been remedied under any circumstances; but advantage was taken of this requirement of the State to make more radical changes and to perfect the system in detail, so that now it is believed the books will show with clearness and accuracy the business of the company. Among the requirements of the railroad commissioners in regard to making the annual return is one that the amount charged to construction and equipment account shall represent the actual cash value of the property. The board has accordingly thought it best to revalue the property, and to correct the books of the company to correspond with such revaluation. This revaluation is therefore given in these returns, and the profit and loss account has been charged with the difference between previous returns and the new valuation."

Chicago, Burlington & Quincy.

The report is for the calendar year 1876. The summary below is from advanced sheets of the report of the President, Mr. Robert Harris, the rest of the report not being in print yet.

The mileage worked (and all substantially owned) at the beginning of the year was 1,297, which was increased Feb. 1 by leasing the 46 miles of the Quincy, Alton & St. Louis Railroad at an annual rental of $42,000. This made the average length worked during the year 1,339 miles. The company also acquired by the purchase of all its stock the 270 miles of the St. Louis, Rock Island & Chicago Railroad, dating from Oct. 1; but this road's accounts were kept separately, and no report of them is given in the President's report.

The equipment at the close of the year consisted of 305 engines; 114 passenger, 2 parlor and 61 baggage, mail and express cars; 4,211 box, 1,725 flat and coal, and 141 way cars; 2 office, 1 pay, 31 dump, 5 wrecking cars, 1 pile-driver, 421 hand and 361 rubble cars.

The capital account stands substantially as follows:

Capital stock ($21,278 per mile)	$27,598,242 51
Outstanding funded debt ($21,203 per mile)	27,501,325 00
Total stock and bonds ($42,481 per mile)	$55,099,567 51

The amount of stock was slightly increased during the year by exchange for some convertible bonds ($85,500). By the contract with the Burlington and Missouri River Company its stock was to be taken in exchange for Chicago, Burlington & Quincy stock. This exchange had progressed so far that at the close of 1876 but $370,432.51 of the former company's stock remained outstanding. This stock is entitled to the same dividends as Chicago, Burlington & Quincy stock. The object of the exchange is, we believe, to give the latter company substantial ownership of the Burlington & Missouri River Railroad, there being legal obstacles to a formal consolidation.

Considerable changes were made in the funded debt, almost exclusively by new issues to retire maturing old ones. In this way $2,000,500 of 7 per cent. bonds due in 1903 were issued, $22,750 of which, however, were devoted to construction expenditure. The gross result was a reduction of $38,250, due to the conversion of bonds into stock.

During the year $132,000 of Chicago & Iowa bonds were bought under a traffic contract for $126,556.93, and $57,963.17 Kansas City & Cameron bonds for $57,963.13. Of the latter $15,000 were sold for $14,616.67. The balance of both was placed in a sinking fund.

Besides the stock and funded debt the capital account shows $414,232.40 of accounts payable at the close of the year and $2,043,575 of bills payable, bringing up the liabilities to $57,557,374.91. But $1,985,083.05 of the bills payable were on account of the St. Louis, Rock Island & Chicago road, and represent an addition of 270 miles of road to the property. Since the close of the year reported a sale of bonds has been made to fund this debt. A note to the report states that $2,200,000 of an issue of $2,500,000 5 per cent. bonds had been sold for this purpose, realizing $1,925,000. When the entire issue has been made, the company will have a funded debt of $30,001,325, secured on 1,567 miles of road, or $19,147 per mile, the new issue being at the rate of only $9,260 per mile. The interest charge per mile on the new purchase will thus be $463.

The assets of the company were $6,179,566.48 in excess of its liabilities.

The earnings and expenses of the property during the two years past have been:

	1876.	1875.	Inc. or Dec.	P. c.
Average length worked	1,339 miles.	1,268 miles.	Inc.. 71 miles.	5.6
Earnings:				
Freight	$8,821,225 16	$8,502,617 37	Inc..$318,607 79	3.7
Passengers	2,653,888 54	2,677,942 44	Dec.. 24,053 90	0.9
Miscellaneous	528,836 75	557,888 36	Dec.. 29,051 61	5.2
Total	$12,003,950 45	$11,738,488 17	Inc..$265,402 28	2.3
Work'g expenses, rentals & taxes	6,813,999 82	6,518,644 08	Inc.. 295,355 74	4.5
Net earn'gs	$5,189,950 63	$5,219,844 09	Dec.. $29,893 46	0.6
Per cent. of expenses	56.78	55.50		
Earn'gs per mile	$3,969 00	$9,258 00	Dec.. $289 00	3.1
Exps. per mile	5,089 00	5,141 00	Dec.. 52 00	1.0
Net earnings per mile	3,880 00	4,117 00	Dec.. 237 00	5.7

The only information as to the amount of business done given in this part of the report is in this statement:

	1876.	1875.	Increase.	P. c.
No. of passengers carried	2,215,783	2,019,484	196,299	9.8
Passenger mileage	99,238,481	97,930,449	1,308,032	1.3
No. of tons hauled	2,892,614	2,711,992	180,622	6.7

This indicates a considerable increase of traffic, resulting, as seen above, in slightly greater earnings and expenses. That the earnings were not increased more nearly in proportion to the number of persons and tons carried President Harris attributes largely to the reductions of rates in compliance with the Iowa law. The average receipt per passenger per mile was 2.674 cents, against 2.735 cents in 1875.

The net earnings above were increased by interest and exchanges and decreased by payment of the contested tax of a previous year, so as to become $5,189,249.53.

These net earnings are accounted for as follows:

Interest on bonds ($1,536 per mile)	$1,991,956 70
Dividends (10 per cent.)	2,749,068 37
Rents of tracks and depots	84,263 13
Adjustment of old claim for U. S. tax	24,940 83
Transferred to sinking fund as required by mortgage	194,092 00
Total	$5,044,308 12
Surplus	144,941 41

A detailed statement is given of what constitute the $6,179,566.48 of assets above liabilities. No less than $3,187,592 of them are in sinking funds; $1,027,950 has been expended for construction for which there is no provision for issuing bonds, and $956,552 has been so expended, but with provision for issuing 7 per cent. bonds to represent it. The remainder is represented by $382,000 of local aid in Iowa, by $545,000 of cash, supplies on hand, etc., and $80,000 by sundry investments.

As an indication of the position of the securities of this company, we find:

Net earnings per mile	$3,880
Interest charge	1,536
Dividends	2,150

The net earnings last year, therefore, were about 2½ times the interest due, and the surplus above interest (some of which, however, was required for sinking funds, etc.,) was about 11 per cent. on the stock.

The construction account was increased during the year by the expenditure of $307,345.79 for road and buildings and $72,017.50 for equipment. Iron was renewed with steel for 72.14 miles during the year, the entire cost being charged to maintenance, and the company has run 461 miles of steel track. There remains but 18.2 miles of iron in the main track between Chicago and Burlington; 41 miles between Galesburg and Quincy, 44½ between Galesburg and Peoria, and 149.2 between Burlington and Plattsmouth.

The payments for car service during the year exceeded the receipts by nearly $150,000, and a gradual increase of the rolling stock is recommended.

Of the 60,371¼ acres of the land grant remaining at the beginning of the year, more than one-half (31,702 acres) was sold; but contracts for the sale of 16,126 acres were cancelled, and at the close of the year 44,796 acres remained unsold. The net sales amounted to nearly $200,000. The receipts of the Land Department were $280,000 in excess of its expenses, and it turned over $265,078 to the trustees of the land-grant mortgage during the year. The land remaining is estimated to be worth $5 per acre; and this value plus the sums due on contracts for principal and interest and the sum already paid into the sinking fund are estimated to amount to about $4,900,000, while the outstanding land-grant bonds amount to $5,058,350, so that they are likely to be cancelled without taxing the resources of the railroad to any considerable extent.

The President gives the following

SUMMING UP.

"In summing up results, it will be seen that we have passed through a year of great dullness in general business; but, with the help of fair crops in the country through which the road passes, have accumulated a surplus beyond our usual dividend of $339,023.41, which has been used in paying $194,082 into our sinking fund; and the balance, $144,941.41, has been used for new construction in Iowa.

"We have our main track in Illinois nearly all relaid with steel, and are steadily replacing iron with steel on the main line in Iowa.

"Our road and equipment are in good order, but some additional rolling stock is required. What funds we need for equipment and for construction in Illinois we can raise, when necessary, by selling 7 per cent. consolidated bonds, authorized by our mortgage for that purpose.

"For construction in Iowa no bond fund is provided; and we must look for money needed for such construction to future surplus earnings, or must realize it from the assets which now represent the surplus of past years, as we have heretofore done; but, as an offset to this drain upon our resources, our lands and land fund in Iowa have given very satisfactory additions to the sinking fund for meeting our land mortgage bonds upon that portion of our road."

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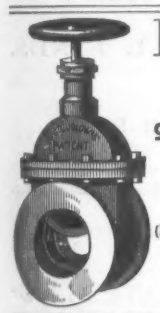

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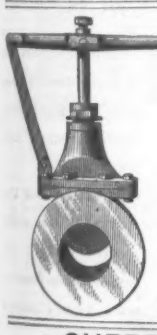

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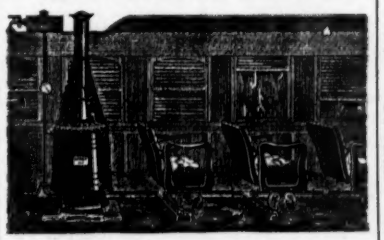

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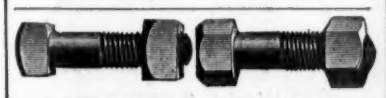

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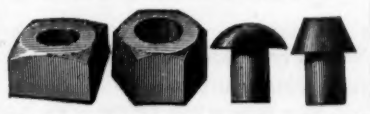

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ENGAGEMENT DESIRED BY AN ENGINEER with a thorough technical education, and experience in designing Iron Bridges, Roofs and Special Machinery. Was one of the inspectors of the St. Louis Bridge. Address C. S. D., P. O. Drawer 9, Wolcott, N. Y.

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POSITION DESIRED ON SOME LIVE Railroad. Am well posted as to general Railroad Accounts and the Freight traffic. Railroad managers desiring an energetic and competent man will address "AUDITOR," RAILROAD GAZETTE Office, 73 Broadway, New York.

WANTED—A SITUATION AS SHORT-hand writer for some railway official. 6 years' experience. GEO. P. BENEDICT, Litchfield, Mich.

WANTED.—SITUATION BY A MEchanical Draughtsman of twenty years' experience, four years of which he has been employed exclusively on iron bridges and roofs. Has a knowledge of both theory and practice of American system of bridge construction and is familiar with railway work from driving the first stake to finished road. Can show designs covering his field of experience in engineering. Address "DESIGNER," 387 Cass avenue, Detroit, Mich.

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OFFICIAL.

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ASHTABULA, OHIO,

in the case arising out of the failure of the

RAILWAY BRIDGE

at that place, Dec. 29, 1876.

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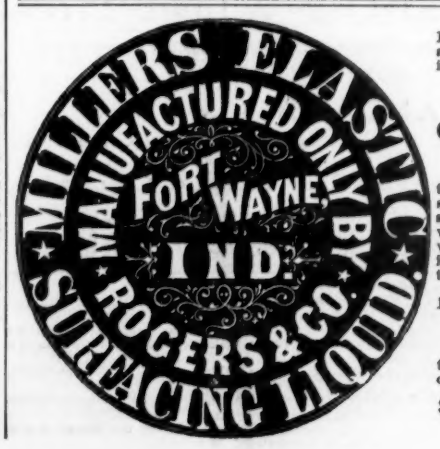

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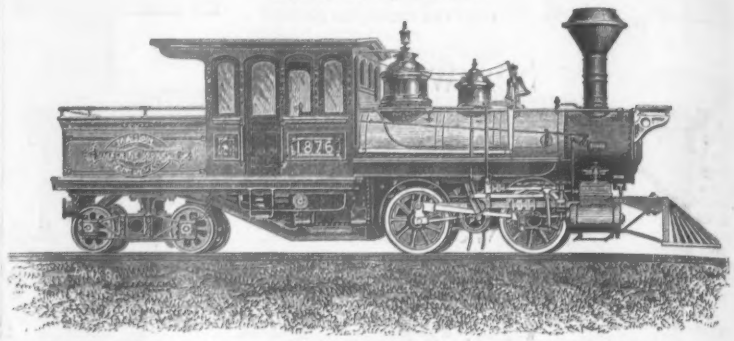

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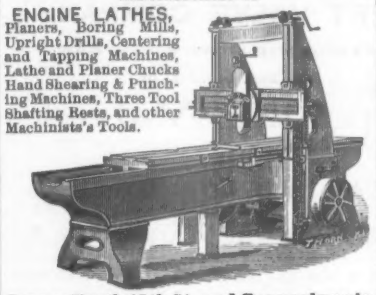

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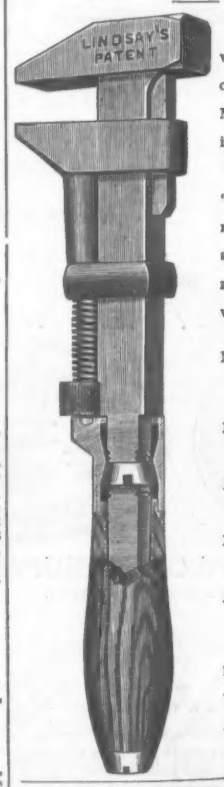

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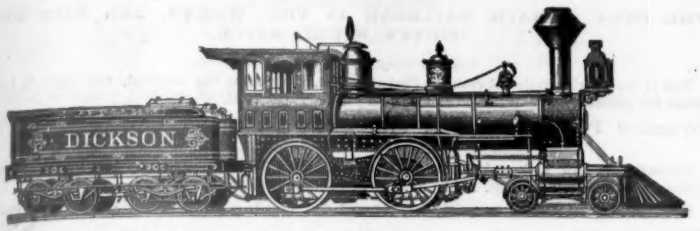

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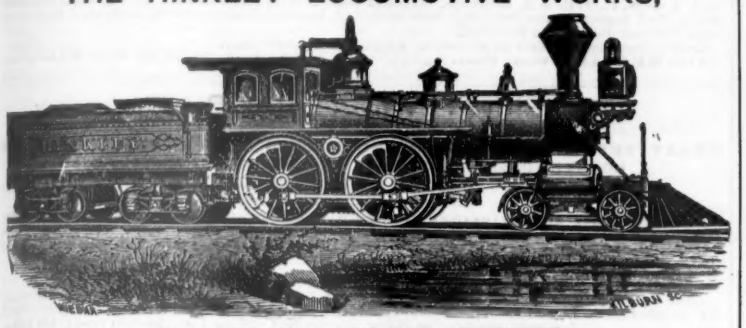

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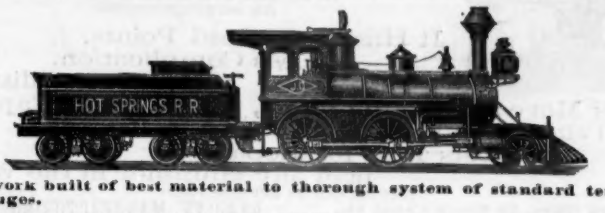

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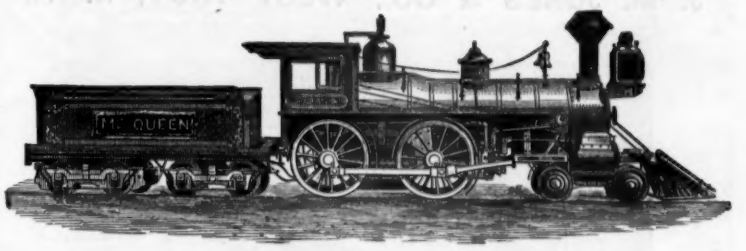

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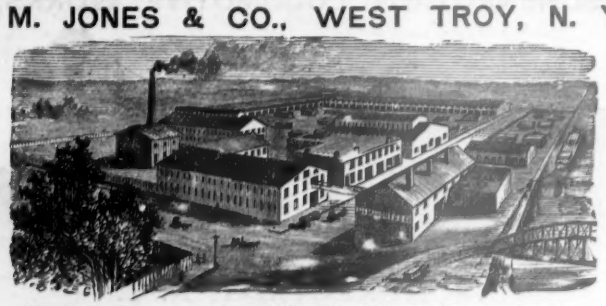

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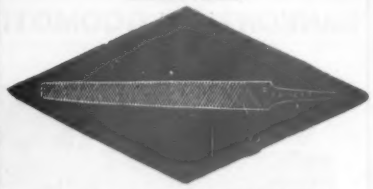

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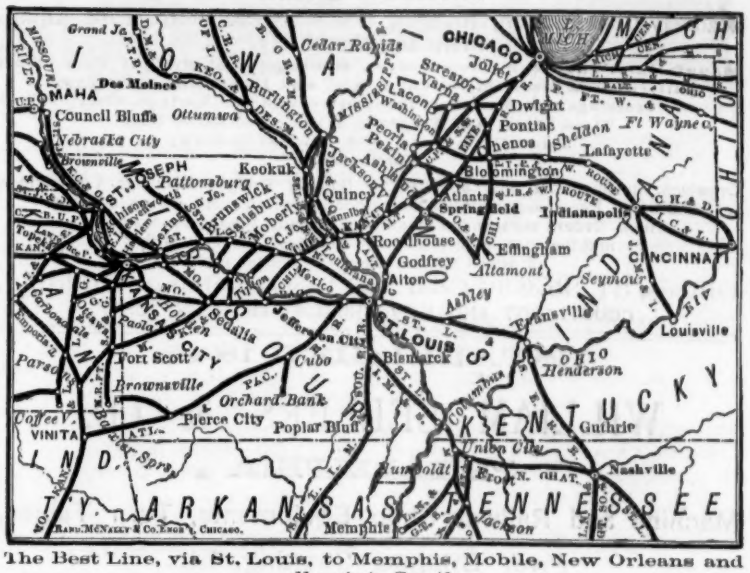

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DUBUQUE AND SIOUX CITY LINE.

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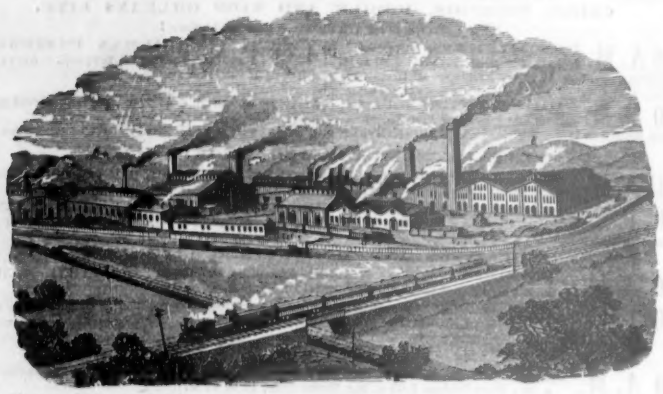

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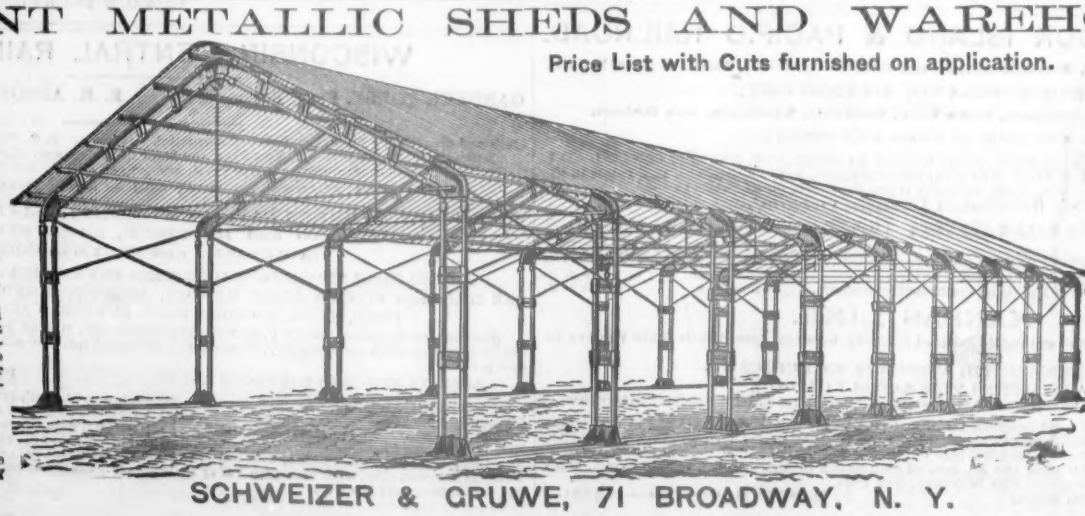

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